# A Life without Gluten:

## Dietary Adherence, Physical Activity and Motives

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*I would like to dedicate my Master's Thesis to my parents and Grandfather. Without their continued support, love and encouragement I would not be where I am today. I appreciate everything you all have done to make my education a success. Thank you.*

## Abstract

The purpose of this study was to look at individuals living on a gluten-free diet (GFD), their dietary adherence, PA levels and the reasons why they engage in these lifestyle behaviours consistent with Organismic Integration Theory (Deci & Ryan, 2002). Participants ($N$ = 202; $M_{age}$ = 42.35 years, $SD_{age}$ = 12.43 years) completed a series of online questionnaires. GFD adherence (74.7%) across the previous week was consistent with existing literature (Dowd et al., 2013), but participant physical activity scores were higher than reported normative values ($p$ = .00; Wilson et al., 2010). Specific motives predicted gluten-free dietary adherence (i.e., integrated and identified regulations) and PA (i.e., intrinsic and identified regulations; $p < .05$). Findings may be used by health professionals to inform behavioural interventions consistent with OIT (Deci & Ryan, 2002).


*Keywords:* Gluten-free diet, physical activity, dietary adherence, motivation, Celiac Disease

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# Chapter 1: Literature Review

"Gluten" is a protein found in a variety of food products; most commonly in those made with wheat, rye and/or barley (Green & Cellier, 2007; Ludvigsson, Biagi, & Corazza, 2014). Living on a gluten-free diet (GFD) involves the non-ingestion of any product that contains this protein (Lammers, Vasagar, & Fassano, 2014). Common foods that contain gluten are breads, pastas and cereals, but there are also those that may not be so obvious including processed meats, soups, baked goods, and even some medications (Health Canada, 2008).

The prevalence of individuals living on a GFD has become more common (Canadian Digestive Health Foundation, 2014; Niewinski, 2008) with current estimates suggesting that approximately 4.3 million Canadians have eliminated or reduced gluten from their diet (Heydon, 2013). The most common reasons identified for committing to eating gluten-free products includes a diagnosis of intolerance (21%), a medical condition (21%), or a lifestyle choice (e.g., support of family members; 15%; Heydon, 2013). For those experiencing a negative reaction to the ingestion of gluten either due to intolerance or a medical condition; three conditions have been identified (Lammers et al., 2014). A brief overview of each of the three conditions linked to aversive reactions to gluten protein follows.

## Celiac Disease

Celiac disease (CD) is an inherited chronic small intestinal immune-mediated enteropathy (Lammers et al., 2014; Ludvigsson et al., 2014) and is the most common heredity autoimmune disorder (Green & Jones, 2006). This condition causes an inflammatory response which damages the lining of the small intestine (villous atrophy) resulting in the body's inability to absorb necessary nutrients (Green & Cellier, 2007;

Health Canada, 2012; Ludvigsson et al., 2014; Niewinski, 2008). CD is diagnosed through blood tests, a small intestine biopsy and the reversal of symptoms when gluten is eliminated from the diet (Green & Cellier, 2007; Health Canada, 2012; Lammers et al., 2014). Approximately 1% of the population is presently diagnosed with CD (Green & Cellier, 2007; Health Canada, 2012; Ludvigsson et al., 2014; Niewinski, 2008), however prevalence rates may actually be higher as CD is often mis-diagnosed as another condition (e.g., irritable bowel syndrome) or underdiagnosed (Green et al., 2001; Ludvigsson et al., 2014; Niewinski, 2008). According to the Canadian Celiac Health Survey the average delay in correct diagnosis was 11.7 years (Cranney et al., 2007).

Individuals at greater risk of being diagnosed with CD are those with a direct relative living with CD (1 in 22 people), being female (2 to 3 times more likely) and those living with osteoporosis, anemia, type I diabetes, thyroid disease or liver disease (Cranney et al., 2007; Green & Cellier, 2007; Lewis et al., 2014; Ludvigsson et al., 2014). The risk of being diagnosed with CD can also increase due to environmental factors such as being bottle fed and/or the early introduction of gluten into the child's diet before 4 months of age (Green & Cellier, 2007; Ludvigsson et al., 2014).

CD manifests itself at any age and is often associated with symptoms such as: Diarrhea, constipation, vomiting, malnutrition, chronic fatigue and joint pain (Cranney et al., 2007; Green & Cellier, 2007; Health Canada, 2012; Lammers et al., 2014; Ludvigsson et al., 2014). It is estimated that CD costs the Canadian health care system 2.5 million dollars annually (Canadian Digestive Health Foundation, 2014; Fedorak, Sitzer & Bridges, 2012). Additional costs occur after diagnosis, due to recommended annual check-ups (Fedorak et al., 2012). Indirect costs have also been associated with a

diagnosis of CD including food (i.e., on average gluten-free products cost 242% more than products that contain gluten; Fedorak et al., 2012) and inconvenience linked to the need to purchase gluten-free products in specialty stores (Freeman, 2008).

A diagnosis of CD heightens the risk of various co-morbidities including small intestine malignancies, osteoporosis, lymphoma, reduced fertility, infertility and migraines (Cranney et al., 2007; Green et al., 2001; Lammers et al., 2014; Lewis et al., 2014). CD has additionally been linked with an increased risk of psychological conditions such as depression and anxiety (Hallert et al., 2003; Lammers et al., 2014; Lewis et al., 2014). CD may also cause distress due to restrictions in daily living and ultimately reduced quality of life; specifically in women (Hallert et al., 2003). Additionally, researchers have suggested that neurological complications such as dementia, ataxia, epileptic seizures, brain atrophy, cognitive impairment and peripheral neuropathy may be present in approximately 10% of people living with CD (Barella, 2008).

**Wheat Allergy**

A wheat allergy involves an allergic response to the ingestion of wheat, which could have an effect on the skin, gastro-intestinal system, or the respiratory tract (Lammers et al., 2014). Often linked to a genetic predisposition, the prevalence of a wheat allergy ranges from 0.5 - 9% of the population (Lammers et al., 2014). The diagnosis of a wheat allergy is determined from a positive test on an allergy skin prick test and the absence of symptoms when wheat is not ingested (Lammers et al., 2014). This allergy, although not an autoimmune condition, is still associated with numerous harmful effects on the body (Lammers et al., 2014). Extending beyond symptoms

presented with CD, a wheat allergy may also be associated with stomach pain, bloating, hives, atopic dermatitis, urticarial, rhinitis and in the rare circumstance anaphylaxis, which has been linked to death (Lammers et al., 2014). Although generally thought to be irreversible, some researchers have suggested an individual can outgrow this allergy (Lammers et al., 2014).

**Non-Celiac Gluten Intolerance**

Non-Celiac Gluten Intolerance is when an individual experiences a negative physical reaction to the ingestion of gluten in the absence of testing positive for CD or a wheat allergy (Lammers et al., 2014). The diagnosis of this condition involves the reversal of symptoms when removing gluten from an individual's diet in combination with a negative test for the other two conditions (Lammers et al., 2014). This chronic condition has similar symptoms to both CD and a wheat allergy (Lammers et al., 2014). More prevalent than CD, Non-Celiac Gluten Intolerance ranges between 3 - 6% of the population (Lammers et al., 2014) with the only known treatment being adherence to a GFD (Lammers et al., 2014; Niewinski, 2008).

**Living on a Gluten-free Diet**

Presently, the only treatment for CD, a wheat allergy and Non-Celiac Gluten Intolerance, is the strict exclusion of gluten sources from the diet (Cranney et al., 2007; Green & Cellier, 2007; Lammers et al., 2014; Niewinski, 2008), which can often be a struggle (Kothe, Sainsbury, Smith, & Mullan, 2015). Eliminating gluten from the diet of someone living with CD has been shown to increase the quality of life of the individual and reverse damaging symptoms (Green et al., 2001; Lammers et al., 2014). The severity of the disease, its prevalence and chronic nature has led to calls for increased research

into its etiology, prevention, and management (Canadian Digestive Health Foundation, 2014; Health Canada, 2012). For the purposes of this study, the combination of individuals living with either CD, a wheat allergy or Non-Celiac Gluten Intolerance, will be encompassed under the term medically advised to live on a GFD.[1]

**Adherence to a Gluten-free Diet**

When diagnosed with a gluten-related disorder, the only existing treatment is to eliminate gluten from the diet completely (Leffler et al., 2008; Niewinski, 2008; Vahedi et al., 2003), which in turn can eliminate symptoms and prevent harmful co-morbidities (Niewinski, 2008). Despite the above, researchers have suggested that there is a wide range of variability in adherence to a GFD, with rates ranging from 42% to 91% of individuals (Dowd et al., 2013; Hall et al., 2009; Lanzini et al., 2009; Leffler et al., 2009; Leffler et al., 2008; Niewinski, 2008). Specifically, Dowd et al. (2013) found that 77.43% of their sample adhered to a GFD, which falls around the middle of the range provided above. It has also been suggested that individuals are more likely to mistakenly consume gluten (54%) than to do so intentionally (40.1%; Hall et al., 2013). Again, Dowd et al. (2013) found 37.5% of their sample ($n$ = 144) consumed gluten by accident over the previous week, whereas only 7.6% of their sample ($n$ = 205) reported consuming gluten on purpose. These results align with the idea that mistakenly consuming gluten is more likely than to do so on purpose (Hall et al., 2013).

In attempt to understand the factors linked to adherence to a GFD, researchers have first turned to demographic variables and symptom severity. However, this line of inquiry has resulted in minimal understanding of the factors linked to the non-consumption of gluten. Gender, ethnicity, age, educational level, employment, or the

length of time the individual has been living on a GFD, have not been shown to be predictors of long-term adherence (Leffler et al., 2007; Leffler et al., 2008). Differences in adherence when an individual has been symptomatic vs. asymptomatic have also not been reported (Leffler et al., 2007). Two factors, namely being married and having additional food-related intolerances (e.g., an intolerance to dairy), has been linked to increased adherence to a GFD (Leffler et al., 2007; Leffler et al., 2008). Additionally, researchers have found that when an individual is feeling better, they often adhere less to a GFD (Lanzini et al., 2009).

Extending beyond demographic factors and other medical diagnoses, the challenging nature of the diet (e.g., cost, inconvenience) has also been implicated in adherence (Charalampopoulos, Panayiotou, Chouliaras, Zellos, Kyritsi, & Roma, 2013; Hall, Rubin, & Charnock, 2013). In order to gain a greater understanding as to why individuals chose to adhere to a GFD, motivation should be considered.

**Adherence to a Gluten-free Diet and Motivation**

Various motives have been linked to dietary adherence (Dowd et al., 2013; Zarkadas et al., 2013). It is suggested that feeling desperate, feeling the need to gain or lose weight, wanting to avoid symptoms and decrease the risk of co-morbidities are all primary reasons why an individual would choose to adhere a restricted gluten-free diet (Dowd et al., 2013; Zarkadas et al., 2013). Predictors of mistaken gluten consumption include food preparation by others, lower self-efficacy, and the perceived difficulty of adherence (Hall et al., 2013). Lower self-efficacy, and the perception of the severity of their gluten tolerance, are significant predictors of intentionally consuming gluten (Hall et al., 2013).

Overall, reasons for adherence to a GFD appear complex based on the existing literature. With knowledge of many reasons for adherence recognized, our understanding is still limited given the tenuous link between knowledge and awareness in understanding behaviour change (Dowd et al., 2013; Hall et al., 2013; Zarkadas et al., 2013). Further, understanding GFD adherence has rarely been guided by health behaviour theory. Researchers have found that there are benefits of including theoretical framework (i.e., Theory of Planned Behaviour; Ajzen, 1985) as it helps predict dietary adherence in this cohort (Sainsbury & Mullan, 2011). For example, when individuals had more positive attitudes and higher perceived behavioural control, better intentions to adhere to a strict GFD were noted (Sainsbury & Mullan, 2011; Sainsbury, Mullan, & Sharpe, 2013). Variance in intention (41.0%) and adherence (33.7%) was accounted for, but there is still room for improvement (Sainsbury & Mullan, 2011). This missing variance and the gap in the literature that remains between intention and behaviour (Kothe et al., 2015), suggests that there is merit to looking at other influential theories. Building on Sainsbury and Mullan (2011), Kothe et al. (2015) found that perceived behavioural control and habit influence the association between intention and actual adherence. Variance in intention (24.2%) and adherence (30.4%) was accounted for (Kothe et al., 2015). As the present study adopted OIT (Deci & Ryan, 2002) as a guiding framework, a gap in the extant literature is investigated.

**The Role of Physical Activity**

Researchers have found evidence that suggests an individual's lifestyle can impact disease and the severity of gluten-related disorders (Hall & Crowe, 2011). Additionally, there is evidence that physical activity (PA) has an impact on

gastrointestinal tract diseases (Hall & Crowe, 2011). Considering this growing research, it is important to look into PA as it may impact the progression of gluten-related dietary disorders (Hall & Crowe, 2011). PA is an important preventive health behaviour that encompasses any type of bodily movement where energy is expended above resting rates (Canadian Society for Exercise Physiology [CSEP], 2013). The benefits of engaging in PA at a level corresponding with public health guidelines have been demonstrated across a variety of biomedical (e.g., chronic health conditions such as, osteoporosis; Bouchard, Blair, & Haskell, 2007; Canadian Society of Exercise Physiology [CSEP], 2013) and psychological (Fox & Wilson, 2008) outcomes. Although little is understood about PA participation rates for individuals living on a GFD, Passananti et al. (2013) reported no differences in PA participation between those with CD and those with no gluten dietary restrictions. PA was low for both groups at baseline and 2 and 5 year follow-ups (Passananti et al., 2013).

**Living on a Gluten-free Diet and Physical Activity.** Little information exists specific to the amount of PA engaged in, psychological constructs linked to PA (e.g., preferences, attitudes, motives), and perceived influence of PA on the management of symptoms for those living on a GFD (Barella, 2008; Canadian Diabetes Association, 2012; Celiac.com, 2014; Health Canada, 2012; Niewinski, 2008; Rodrigo, 2006; Stauble, 2013; Sutton-Kerchner, 2014; Vazquez et al., 2000). Further complicating matters is the contradictory nature of existing information attesting to the benefits of PA for this cohort (Barella, 2008; Canadian Diabetes Association, 2012; Celiac.com, 2014; Health Canada, 2012; Kemppainen et al., 1999; Mora et al., 1998; Niewinski, 2008; Rodrigo, 2006; Stauble, 2013; Sutton-Kerchner, 2014; Vazquez et al., 2000). Ultimately it remains

unclear whether PA helps or hinders intestinal health (Barella, 2008; Niewinski, 2008). Further, what we do know about PA is often restricted to individuals living with CD and not all the disorders across the gluten-related spectrum.

Researchers have advocated that the health benefits of PA would translate to an individual on a GFD (Barella, 2008; Niewinski, 2008; Stauble, 2013; Sutton-Kerchner, 2014). For example, being physically active helps increase circulation, which in turn can aid the digestive system that is often compromised in individuals with CD (Sutton-Kerchner, 2014). Besides helping to maintain a healthy lifestyle, some researchers suggest that PA can help to overcome some symptoms/comorbidities of CD (Barella, 2008; Celiac.com, 2014; Kemppainen et al., 1999; Mora et al., 1998; National Foundation for Celiac Awareness, 2011; Rodrigo, 2006; Stauble, 2013; Sutton-Kerchner, 2014; Vazquez et al., 2000). When living on a GFD due to a medical diagnosis, patients are susceptible to lower bone density (Health Canada, 2012; Lammers et al., 2014), which can be maintained or loss minimized through regular PA (Kemppainen et al., 1999; Mora et al., 1998; Rodrigo, 2006; Vazquez et al., 2000), particularly weight-bearing activities (Celiac.com, 2014; Kemppainen et al., 1999; Mora et al., 1998; Rodrigo, 2006; Vazquez et al., 2000). Extending to psychological outcomes, PA has shown its utility to aid in the reduction of depression, anxiety (National Foundation for Celiac Awareness, 2011) and be positively linked with health-related quality of life in individuals with other chronic health conditions (Barella, 2008). As such, it seems reasonable that PA can be beneficial for the psychological health of individuals living with one of the conditions across the gluten-free spectrum (Barella, 2008). Lastly, PA has been implicated in

weight management (Stauble, 2013; Sutton-Kerchner, 2014), which is often a struggle in people living on a GFD (Stauble, 2013; Sutton-Kerchner, 2014).

Engagement in PA may also be a concern as individuals living with a wheat allergy could experience exercise-induced anaphylaxis (Choi, Lee, Ahn, Park & Lee, 2009; Inomata, 2009; Lehto et al., 2003; Palosuo et al., 2003). As exercise-induced anaphylaxis is potentially fatal, individuals with a severe wheat allergy are encouraged not to exercise if any wheat products are consumed (Choi et al., 2009; Inomata, 2009; Lehto et al., 2003; Palosuo et al., 2003). Researchers have also suggested that symptoms of CD may deter PA all together (Canadian Diabetes Association, 2012; Celiac.com, 2014; Health Canada, 2012; Stauble, 2013). Often, individuals living with this condition can experience fatigue, weakness, chronic pain and are susceptible to bruising, which are all suggested to hinder the motivation to be physically active (Canadian Diabetes Association, 2012; Celiac.com, 2014; Health Canada, 2012; Stauble, 2013).

Researchers have suggested that PA should be discussed with professionals when generating a treatment plan (Niewinski, 2008), but recommendations linked to mode, frequency, duration and intensity to promote health while not exacerbating symptoms linked to a gluten-related sensitivity are unknown. Prior to generating such an evidence-base, a more fundamental understanding of how physically active this cohort is and their underlying motives to be physically active while living on a GFD are needed.

**Self-Determination Theory**

Self-Determination Theory (SDT) is a macro-level theory focusing on human motivation and personal growth (Deci & Ryan, 2002). Behaviour, whether it be initiation or maintenance, is examined through multiple sub-theories developed by Deci and Ryan

(2002). The sub-theory that directly addresses quality and quantity of human motivational outcomes is OIT (Deci & Ryan, 2002).

**Organismic Integration Theory.** Deci and Ryan (2002) present a differentiated view of motivation that identifies various behavioural regulations that range in the degree to which they are internalized and integrated into the self. These researchers suggest that humans have the desire for growth, which occurs when a behaviour or experience becomes part of an individual's sense of self through the process of integration (Deci & Ryan, 2002). The degree of integration is based on where the experience falls on an internalization continuum and encompasses the degree to which the behaviour is necessary to the sense of self (see Figure 1; Deci & Ryan, 2002). The more a behaviour is integrated into the sense of self, the more likely the behaviour will be sustained (Deci & Ryan, 2002). Behavioural regulations that are fully internalized are better in quality and become a greater part of the integrated self (Deci & Ryan, 2002).

Intrinsic regulation, the most internalized regulation on the continuum, is where an individual is motivated to participate in a behaviour because of the pure enjoyment and satisfaction associated with engagement (Deci & Ryan, 2002). Deci and Ryan (2002) theorize that this is the best source of motivation and results in the highest integration into the sense of self. Next on the continuum is integrated regulation, which is when an individual is motivated to participate in a behaviour because it incorporates ones values and goals (Deci & Ryan, 2002). This regulation is highly internalized, but not as much as intrinsic regulation due to the fact that it is an external motive (Deci & Ryan, 2002). Identified regulation is when an individual is motivated because the behaviour has personal importance (Deci & Ryan, 2002). This regulation still involves internalization

and although not as strong as behaviour motivated for integrated or intrinsic reasons, it is still integrated into the sense of self (Deci & Ryan, 2002). Next on the continuum is introjected regulation, which is when an individual is motivated to gain positive feelings (e.g., self-esteem) and/or to avoid negative feelings (e.g., shame; Deci & Ryan, 2002). Although this regulation involves some internalization, it is not well integrated into the sense of self (Deci & Ryan, 2002). External regulation is a behaviour that is motivated from an outside source to acquire a reward or avoid negative consequences (Deci & Ryan, 2002). This regulation is not internalized, which results in the worst integration into the sense of self out of all the regulations (Deci & Ryan, 2002). Lastly, amotivation is at the opposite end of the internalization continuum from intrinsic regulation, which occurs when there is a lack of intention and purpose to partake in the behaviour at all (Deci & Ryan, 2002).

Behavioural regulations as conceptualized by Deci and Ryan (2002) are categorized into amotivation, controlled or autonomous motivations. Controlled motivations (i.e., external and introjected regulations) are centered around aspects of life that externally motivate you to participate in a behaviour, whereas autonomous motivations (i.e., identified, integrated and intrinsic regulations) involve different aspects of motivation that come from an internal source (Deci & Ryan, 2002). Researchers have suggested that lasting behaviour change and psychological health is linked to activities endorsed for more autonomous than controlled reasons (Deci & Ryan, 2002).

**Dietary Intake and Motivation**

When looking at motivation through regulations consistent with OIT (Deci & Ryan, 2002), the expected association between autonomous motivation and dietary intake

has been reported (Austin, Guay, Senecal, Fernet, & Nouwen, 2013; Hagger, Chatzisarantis, & Harris, 2006; Rutten, Meis, Hendricks, Hamers, Veenhof, & Kremers, 2014; Shaikh, Yaroch, Nebeling, Yeh, & Resnicow, 2008; Wilson, Grattan, Mack, Blanchard, & Gilchrist, 2012; Wilson, Mack, & Blanchard, 2014), with the relationship holding more strongly for females (Leblanc, Begin, Corneau, Dodin, & Lemieux, 2014). Researchers have found that consuming a healthier diet is more likely to be maintained when individuals are more intrinsically motivated (Rutten et al., 2014). The relationship between the endorsement of controlled motives and eating behaviour has demonstrated no (Shaikh et al., 2008; Wilson et al., 2012a; Wilson et al., 2014) or a negative (Pelletier, Dion, Slovinec-D'Angelo, & Reid, 2004) relationship. Further, Pelletier et al. (2004) reported that controlled motivation positively influenced dysfunctional eating behaviours (e.g., eating binges, self-induced vomiting etc.).

When assessing dietary behaviours of individuals with chronic conditions (e.g., Type 1 Diabetes), motivational constructs linked to OIT have also demonstrated their utility (Austin et al., 2013; Austin, Senécal, Guay, & Nouwen, 2011). Again, researchers have shown that greater autonomous motivation leads to better dietary intake and has an impact on long-term behaviour change (Austin et al., 2013; Austin et al., 2011). In sum, the impact of motivation, consistent with OIT (Deci & Ryan, 2002), on asymptomatic and symptomatic cohorts offers justification for its use in individuals living on a GFD.

**Physical Activity and Motivation**

Deci and Ryan's (2002) OIT has often been used as the lens through which understanding motivation for PA behaviour has been investigated. Evidence from multiple researchers has shown that OIT can be an effective method of assessing PA

behaviour across cross-sectional (Brunet, & Sabiston, 2011; Duncan, Hall, Wilson, & O, 2010; Edmunds et al., 2006; Haerens, Kirk, Cardon, Bourdeaudhuij, & Vansteenkiste, 2010; Wilson, Mack, & Gratton, 2008; Wilson, Rodgers, Fraser, & Murray, 2004; Wilson, Sabiston, Mack, & Blanchard, 2012), longitudinal (Chatzisarantis, & Hagger, 2009; Silva et al., 2010a; Silva et al., 2010b) and intervention-based research (Chatzisarantis, & Hagger, 2009; Silva et al., 2010a; Silva et al., 2010b).

Autonomous motives, specifically intrinsic regulation (Brunet & Sabiston, 2011; Edmunds et al., 2006; Haerens et al., 2010), integrated regulation (Duncan et al., 2010; Wilson et al., 2004), and identified regulation (Brunet & Sabiston, 2011; Haerens et al., 2010; Wilson et al., 2012b; Wilson et al., 2008; Wilson et al., 2004) have demonstrated their importance to predicting PA behaviour. When it comes to controlled regulations identified by Deci and Ryan (2002), results have varied (Brunet & Sabiston, 2011; Edmunds et al., 2006; Haerens et al., 2010). Introjected regulation was found to be a significant positive correlate of PA (Brunet & Sabiston, 2011), however results are equivocal (Edmunds et al., 2006; Haerens et al., 2010). External regulation has demonstrated a non-significant (Haerens et al., 2010), positive (Edmunds et al., 2006), and negative (Brunet & Sabiston, 2011) relation to PA behaviour.

The generalizability of OIT to understanding PA behaviour has extended to asymptomatic and symptomatic populations and the researchers using OIT have continually shown to be at least moderately effective when looking at PA behaviour (Brunet, Burke, & Sabiston, 2013; Brunet & Sabiston, 2011; Edmunds et al., 2006; Haerens et al., 2010; Peddle, Plotnikoff, Wild, Au, & Courneya, 2008). Continuing along the same trend, researchers have demonstrated that when looking at PA across differing

populations (e.g., health condition, age etc.), regulations that are more autonomously endorsed have consistently demonstrated their utility (Duncan et al., 2010; Wilson et al., 2012b; Wilson et al., 2008; Wilson et al., 2004). Overall, it is clear that understanding motivation for PA guided by OIT has generally been supported regardless of design and cohort (Brunet & Sabiston, 2011; Duncan et al., 2010; Edmunds et al., 2006; Haerens et al., 2010; Wilson et al., 2012b; Wilson et al., 2008; Wilson et al., 2004).

**Research Questions and Study Hypotheses**

This study was grounded in the following four research questions: (1) To what extent do individuals living on a GFD (by choice vs. medically advised) adhere? (2) How physically active are individuals living on a GFD in comparison to normative data? (3) Are there differences reported in motivational regulations for consuming a GFD and PA behaviour consistent with OIT (Deci & Ryan, 2002) between those who consume a GFD by choice and those who are medically advised to do so? (4) Do motivational regulations, consistent with OIT, predict dietary adherence and/or PA behaviour in individuals living on a GFD? Based on these research questions the following research hypotheses were derived:

$H_1$: Consistent with Dowd et al., (2013), it was hypothesized that approximately three-quarters of the participants with gluten dietary restrictions would adhere to their medically advised diet. Adherence rates for those who consume a GFD by choice were investigated. As this is exploratory, no formal hypothesis was advanced.

$H_2$: Aligned with Passananti et al. (2013), it was hypothesized that there would be no difference in PA behaviour between individuals living on a GFD to the normative values.

$H_3$: No known literature has examined whether living on a GFD by choice differs from a medically advised GFD when looking at motives for dietary consumption and PA. As such, it was hypothesized that there would be no difference between these groups on behavioural regulations consistent with OIT (Deci & Ryan, 2002).

$H_4$: Consistent with (Brunet & Sabiston, 2011; Duncan et al., 2010; Edmunds et al., 2006; Haerens et al., 2010; Pelletier et al., 2004; Wilson et al., 2012b; Wilson et al., 2008; Wilson et al., 2004), autonomous motives would predict dietary adherence and PA in individuals living on a GFD.

**Significance of Research**

Researchers have suggested that greater insight into why individuals are non-adherent to a GFD are needed (Hall et al., 2009). The inclusion of theory to understand health behaviours may be one way to address this gap (Rimer & Glanz, 2005). To date, there has been limited research incorporating theory on this topic, with the exception of Sainsbury and Mullen (2011). Extending beyond motives, the development of interventions to improve gluten-free dietary adherence or research in general is a major goal (Sainsbury et al., 2013). Incorporating OIT (Deci & Ryan, 2002) allows for a different perspective on gluten dietary adherence that is currently lacking, but one that has shown its utility in other nutrition-based research (e.g., Pelletier et al., 2004, Wilson et al., 2012a). Incorporating a theory that has not been used on a topic, could result in greater insight.

An additional gap in the literature is the comparison of an individual who lives on a GFD by choice to someone who is medically advised to refrain from eating gluten across multiple variables (i.e., dietary adherence, PA, motivation). As approximately

15% of those living on a GFD are doing so by choice (Heydon, 2013) understanding their level of dietary adherence, PA behaviour and motives may be beneficial. Additionally, choosing to consume a GFD has become an increasingly popular nutritional strategy as one-third of American adults are trying to cut gluten from their diet (Consumer Reports, 2014). Gaining knowledge on the 'by choice' group's motives could help determine which motives are endorsed, the strength of the endorsement and whether these motives are similar to what motivates individuals who are medically advised. The combination of these two groups and these variables takes a novel look at the GFD, which could add to the growing research around this topic.

Finally, the proposed research has the potential to address select gaps in the literature. Research is lacking regarding how physically active people living on a GFD are, so any added information on this topic addresses a gap in the literature. Consequently, specific suggestions for PA are often unclear (Barella, 2008; Canadian Diabetes Association, 2012; Celiac.com, 2014; Health Canada, 2012; Niewinski, 2008; Rodrigo, 2006; Stauble, 2013; Sutton-Kerchner, 2014; Vazquez et al., 2000). Being misinformed, not having clear PA recommendations and having access to conflicting information, may deter individuals with gluten-related dietary disorders from participating in PA. Additionally, learning more about PA in this cohort can be beneficial when looking at whether a GFD benefits other aspects of an individuals' lifestyle. It is known that people who are active tend to engage in other healthy behaviours (i.e., consume a healthier diet; Tavares, 2014). Also, Wilson et al. (2014) found that motivation for a behaviour (e.g., PA) could likely impact an individual's behavioural engagement in a different health behaviour (e.g., dietary intake), when

autonomous motivation is involved. These findings justify the value of looking at PA behaviour and support the need to further our understanding in this cohort.

## Chapter 2: Methods

### Participants

Participants ($N$ = 202) in this study were adults aged 18-64 years who self-identified as living on a GFD for reasons that were either medically advised (i.e., CD, a wheat allergy, Non-Celiac Gluten Intolerance) or by choice. The minimum target sample size ($N$ = 128) was determined based on a moderate effect size, an alpha level of .05, and a power estimate of .80, for PA, dietary adherence and behavioural regulations consistent with the OIT (Cohen, 1992).

Participant recruitment was guided by the following inclusion criteria: (a) self-identified as living on a gluten-free diet, (b) have consented to participate, (c) between the ages of 18-64 years, (d) must be able to understand and speak English, (e) willing to complete a series of questionnaires and, (f) must have access to both a computer and Internet given the process through which data collection was taken.

### Instrumentation

**Demographics**. Demographic variables included: Age, gender, ethnicity, education, employment status, condition diagnosis, duration of time living on a GFD, height and weight. These demographic variables were used to describe the sample and aid in condition placement.

**Adherence to Gluten-free Diet.** Participants responded to two items regarding adherence over the previous week (Dowd et al., 2013). The first item addressed the frequency of accidental gluten ingestion (i.e., consuming gluten without knowing, but

then experiencing symptoms) and the second addressed purposeful gluten ingestion. Based on the sum of these scores, GFD adherence was determined, where a score of zero is completely adherent.

**Physical Activity.** The Leisure-Time Physical Activity Questionnaire (LTEQ; Godin & Shephard, 1985) was used to assess PA. Participants were given this three-item instrument in order to measure how often each individual participated in mild, moderate and vigorous PA. The single item indicator assessing the frequency of "sweating" across a typical week was not included. Instructions directed participants to indicate the number of times across a typical seven day period strenuous (e.g., heart beats rapidly), moderate (e.g., not exhausting) and mild activity (e.g., minimal effort) was engaged in for at least 15 minutes. The examples for engaging in mild, moderate and vigorous physical activity were consistent with Trinh, Plotnikoff, Rhodes, North and Courneya (2011). The total amount of PA was derived by taking the sum of participant responses when multiplying the frequencies of the three intensities (i.e., mild, moderate, vigorous) by three, five and nine respectively. This total is an estimate of the total METs. Correlations between MET scores and indices of physical fitness demonstrates concurrent validity for the LTEQ (Jacobs, Ainsworth, Hartman, & Leon, 1993) with support for test scores in young adults (Wilson, Rodgers, Loitz, & Scime, 2006) and those living with a chronic condition (Motl, McAuley, Snook, & Scott, 2006). The test–retest reliability of overall LTEQ scores across 2 weeks has been reported as 0.74 in a sample of healthy adults (Godin & Shephard, 1985).

**Motives for Eating.** To measure what motivates an individual to consume a GFD, a modified version of the Regulation of Eating Behaviours Scale (REBS; Pelletier et

al., 2004) was administered. This instrument uses a 7-point Likert scale to respond to a series of statements that correspond to personal motives for dietary behaviour. Responses were made based on the following instructional stem "Why are you eating a gluten-free diet?". Participants were asked to indicate where they fall on the scale from 1 (Does not correspond at all) to 7 (Corresponds exactly). Sample items, separated into OIT subscales are, "..because it's fun to create meals that are gluten-free" (intrinsic motivation), "..because eating a gluten-free diet is congruent with other important aspects of my life" (integrated regulation), "..because I believe it's a good thing I can do to feel better about myself in general" (identified regulation), "..because I would be humiliated if I was not in control of my gluten-free diet" (introjected regulation), "..because other people close to me insist" (external regulation), and "..I can't see how my efforts to eat a gluten-free diet are helping my health situation" (amotivation; Pelletier & Dion, 2007). However, researchers have found amotivation to be problematic as it often does not met the assumption of normality (Pelletier et al., 2004, Study 1 and 2), so amotivation was removed prior to running analyses.[2] Evidence supporting the reliability and construct validity of the original REBS scores in asymptomatic, young adults (Pelletier et al, 2004, Study 1 and 2; Pelletier & Dion, 2007) and individuals seeking medical assistance from clinicians (Pelletier et al, 2004, Study 3) have been reported.

**Motives for Physical Activity.** To assess what motivates an individual to partake in PA, the Behavioural Regulation in Exercise Questionnaire (BREQ-2R; Markland & Tobin, 2004; Wilson et al., 2006) was completed. The BREQ-2R is a self-report instrument that assesses behavioural regulations that align with Deci and Ryan's (2002) OIT. This 23-item instrument assesses six regulations (i.e., intrinsic, integrated,

identified, introjected, external and amotivation) through responses identified on a 5-point scale. This scale's response options begin with 0 (*not true for me*) and end with 4 (*very true for me*). For the purposes of this study, item wording was changed from "exercise" to "physical activity" to more accurately represent the variables aligned with study objectives. Item responses followed the motivational stem of "Why are you physically active?". Sample items included in the modified BREQ-2R were: Intrinsic motivation ("I enjoy my physical activity sessions"), integrated regulation ("I am physically active because it is consistent with my values"), identified regulation ("I get restless if I am not physically active regularly"), introjected regulation ("I feel guilty when I'm not physically active"), extrinsic regulation ("I am physically active because other people say I should") and lastly amotivation ("I don't see a point in being physically active"). Again, amotivation was removed prior to running analyses, which is consistent with previous research (Wilson et al., 2006), as amotivation is more likely to influence behaviour in a more sedentary populations. Construct validity (Markland & Tobin, 2004; Wilson & Rodgers, 2004; Verloigne et al., 2011) of BREQ-2R scores and internal consistency reliability and temporal stability in an exercise context have been demonstrated (Duncan et al., 2010; Wilson et al., 2006). Support for the validity and reliability of BREQ-2 scores adapted to physical activity contexts have been noted (Vancampfort et al., 2013; Verloigne et al., 2011).

**Procedures**

The current study uses a non-experimental cross-sectional design with purposive sampling procedures. Following ethical clearance from the Brock University Bioscience Research Ethics Board (File #: 14-099; see Appendix A), participant recruitment was

conducted in two phases and followed recommendations from Dillman (2007) to minimize biases associated with different recruitment methods. The first phase of recruitment was conducted by placing posters around Brock University (see Appendix B) and recruitment through undergraduate and graduate courses using a standardized verbal script (see Appendix C). The second phase of recruitment consisted of study announcements publicized via the internet on social media websites (e.g., Facebook) and CD support groups (e.g., Canadian Celiac Association; see Appendix D). The recruitment strategy for contacting CD support groups was documented (see Appendix E). Regardless of recruitment method, interested participants were provided with a link to a secured internet-based survey (www.fluidsurveys.com). Data collection began January 2015 and was completed by February 2015.

Regardless of recruitment method, participants received a Letter of Invitation (see Appendix F) and Informed Consent form (see Appendix G) and were provided the opportunity to ask questions regarding the study. Informed consent was required prior to test administration. Those who elected not to provide their consent were redirected away from the study webpage and thanked for their time and consideration. Those who consented were then asked to complete a series of questionnaires that they could access online through a secured internet site (www.fluidsurveys.com) which took approximately fifteen minutes to complete (see Appendix H). The link was provided to each participant through email.

When the data collection was completed, each participant received a Debriefing Form (see Appendix I), and given the option to leave their contact information if they would like to receive aggregate-level summary of the major findings of the study. These

results will be sent out to these participants via email or hard copy approximately 6 months following the data collection period.

**Data Analysis**

Inspection of missing data and non-response error was first assessed through Missing Values Analysis in SPSS. Missing data was replaced using a multiple imputation procedures adopting an expectation-maximization (EM) algorithm which results in a more realistic estimate of variance (Tabachnick & Fidell, 2001). Prior to running these analyses, items assessing amotivation were eliminated.

Univariate normality (i.e., means, standard deviation, skewness and kurtosis) of the data was then inspected. Internal consistency reliability estimates (Cronbach's α, Cronbach, 1951) were computed to determine reliability for all scores from study variables with the exception of the two item GFD adherence measure and LTEQ.

For hypothesis 1, descriptive statistics were run to determine dietary adherence across the previous seven days across the sample. A one-sample *t*-test was run for hypothesis 2 in order to compare the difference between the sample's mean and normative values (Godin & Shephard, 1985; Wilson et al., 2010). Prior to the inferential tests, data was tested for conformity to statistical assumptions (i.e., normal distribution and independence). Next, estimates of effect size interpreting Cohen's *d* were run to determine whether there were differences between those who consumed a GFD by choice or were medically advised to do so on motivational regulations for diet and PA, consistent with hypothesis 3.[3] Differences between the grouping variable and motivational regulations for consuming a GFD and PA were examined by interpreting

Cohen's *d*, where a value of .20 indicates a small effect, .50 indicates a moderate effect and .80 indicates a large effect.

Lastly, two multiple regression analyses were run to test hypothesis 4. Using simultaneous predictor variable entry, the relationship between dietary motives spanning the OIT continuum and adherence to a GFD were tested in the first regression analysis. The second analysis employed the same variable entry procedure to examine the relationship between motivational regulations for PA and LTEQ scores. Each regression model was evaluated using varied indices (e.g., adjusted $R^2$, standardized beta weights and structure coefficients) following the examination of statistical assumptions (e.g., linearity, independence). The effect size was then calculated through Cohen's eta squared (Cohen, 1988) where a value of .01 suggests a small effect, .06 suggests a medium effect and .14 suggests a large effect.

# Chapter 3: Results

## Preliminary Data Analysis

A total of 303 participants accessed the online survey to receive further details linked to study participation. Of those who accessed the survey, 101 cases were removed from consideration for a variety of reasons. Sixty-three participants were removed because they did not provide consent to participate. An additional eight cases were removed as they did not meet inclusion criteria. Non-responders were those who consented to participate but failed to provide responses to either of the instruments taping into motivational regulations, physical activity or gluten-free dietary adherence. In total, thirty non-responders were removed from further consideration. One participant did not complete any of the items in the BREQ-2R, however this case was retained as their data could be used to test hypotheses not linked to motivational regulations for PA. Usable data for testing study hypotheses included responses from 202 individuals.

Partial responders were defined as individuals who provided consent and completed the majority of the survey instruments but did not respond to one or more specific items. No missing data was found for the LTEQ and the 2-item GFD adherence instrument. Missing data from partial responders was 4 cases (2.0%) for any REBS item and 6 cases (3.0%) for any BREQ-2R item. A Missing Values Analysis was performed for all REBS and BREQ-2R subscales in this study. The majority of the Little's MCAR test values were $p \geq .05$. However, REBS intrinsic regulation ($p = .02$), BREQ-2R intrinsic regulation ($p = .00$) and BREQ-2R external regulation ($p = .00$) subscales were all $\leq .05$ suggesting that patterns of missing data for these subscales could not be deemed

missing completely at random. An expectation maximization algorithm was then used to replace missing data from those participants classified as partial responders.

**Sample Characteristics**

Participants ($N$ = 202; $M_{age}$ = 42.35 years; $SD_{age}$ =12.43 years) were primarily female ($n$ = 185; 92.0%; see Table 1). Most identified themselves as married/common law (71.90%), having completed a University Degree (35.80%), currently employed (69.70%), and Caucasian (96.0%). The average Body Mass Index (BMI) values for this sample were ($M_{BMI}$ = 25.22 kg/m$^2$; $SD_{BMI}$ = 5.42 kg/m$^2$). On average participants identified as living on a GFD for approximately six and a half years ($M_{months}$ = 79.40; $SD_{months}$ = 88.46; *Range* = 1 - 420) due to being diagnosed with Celiac Disease (76.1%). A series of parametric (e.g., *t*-test) and nonparametric (e.g., chi-square) tests were run across all the appropriate variables to determine if there were differences between someone who consumes a GFD by choice or because they are medically advised to do so. The 2-item GFD measurement ($t$(23.61) = 2.12, $p$ = .045) and REBS external regulation ($t$(36.91) = -2.46, $p$ = .02) were the only variables demonstrating significant differences between groups. More specifically, the 'by choice' group reported greater non-adherence ($M$ = 1.22; $SD$ = 1.86) compared to the medically advised ($M$ = .38; $SD$ = .98), while the medically advised reported greater external regulation ($M$ = 2.20; $SD$ = 1.44) than the 'by choice' group ($M$ = 1.65; $SD$ = .94).

**Descriptive Statistics and Estimates of Internal Consistency**

Descriptive statistics, estimates of normality and internal consistency of test variables were calculated (see Table 2). Based on the sum of the 2-item measure of dietary adherence, it was revealed that the majority of the sample ($n$ = 146; 72.3%)

adhered to a strict GFD with a range from 0 to 10 times over the last week consuming gluten. Non-adherers reported more accidental ($n$ = 49; 24.3%) than purposeful gluten consumption ($n$ = 14; 6.9%) over the past week. Participants endorsed integrated ($M$ = 5.48; $SD$ = 1.37) and identified ($M$ = 5.48; $SD$ = 1.55) regulations for eating a GFD most strongly on the REBS scale.

On average, participants reported engaging in 65.07 ($SD$ = 47.70) METS of physical activity during a typical week. Identified ($M$ = 2.91; $SD$ = .97) and intrinsic ($M$ = 2.69; $SD$ = 1.18), regulations were on average most strongly endorsed motives for engaging in PA based on BREQ-2R scores. The relationship between PA and GFD adherence was non-significant ($r_{12}$ = .05, $p$ = .23).

Next, the assumption of normality was interpreted by looking at the values of skewness and kurtosis for each motivational regulation subscale for both the REBS and BREQ-2R. Skewness and kurtosis values for both the REBS and BREQ-2R subscale variables fell within an acceptable range (-1.05 to 1.84 and -1.09 to 1.08 respectively), with the exception of BREQ-2R external regulation (3.36), which was somewhat leptokurtic (George & Mallery, 2010).

Cronbach's coefficient alpha (Cronbach's α; Cronbach, 1951) was used to determine the reliability estimates of internal consistency. Estimates of internal consistency for REBS scores ranged from 0.57 to 0.83 ($M_\alpha$ = 0.68; $SD_\alpha$ = 0.10) and 0.82 to 0.96 ($M_\alpha$ = 0.89; $SD_\alpha$ = 0.05) for BREQ-2R scores.

**Main Analysis: Dietary Adherence**

In an effort to compare adherence in the present sample to that reported in existing literature (i.e., 77.43% adherence rate; Dowd et al., 2013) participants living on a GFD by choice were removed prior to running this analysis. For those medically advised

to live on a GFD ($n$ = 178), the majority of the sample (74.7%) completely adhered to their GFD over the previous week with a range of 0 to 10 times consuming gluten. As such, it appears as though participants in the present investigation were similarly adherent to those reported in the literature. Meanwhile, when just looking at the adherence rates of the by choice group, approximately half of the sample (56.5%) adhered to a strict GFD across the previous 7 day period.

**Main Analysis: PA compared to normative values**

No outliers were removed before running the analysis for hypothesis 2. Based on the skewness and kurtosis values presented in Table 2, the assumption of normality were acceptable as values were less than $\pm$2.00 (George & Mallory, 2010). The assumption of independence was most likely met given the method of data collection for the present study and the samples used as normative values.

A one-sample $t$-test was run to compare differences between scores on the LTEQ in the present sample with normative values reported by Wilson et al. (2010) and Godin and Shephard (1985) in university aged ($N$ = 2714) and middle aged adults ($N$ = 306) respectively. Participants were significantly more physically active ($t(201) = 4.13$, $p$ = .00) than the normative value of 51.21 METS reported by Wilson et al. (2010) and 45.80 METS ($t(201) = 5.74$, $p$ = .00) as recorded by Godin and Shephard (1985).

**Main Analysis: Differences between groups in motivational regulations for living on a GFD and PA**

Estimates of effect size were calculated to examine differences between individuals who consumed a GFD by choice ($n$ = 23) and those who consumed a GFD due to medical advisement ($n$ = 178), on motivational regulations for dietary adherence

(see Table 3) consistent with OIT (Deci & Ryan, 2002). Negligible differences across motives were reported between groups with the exception of intrinsic and extrinsic regulations. Those choosing to live on a GFD reported more intrinsic reasons (Cohen's *d* = 0.17) than those who do so for medical reasons. The magnitude of effect approached a small difference. In contrast, external regulation approached a moderate effect size (*d* = -0.45), which indicates that those living on a GFD due to medical advisement more strongly endorsed this motive than those choosing to consume a GFD.

Estimates of effect size were then calculated to test for differences between the same groups (by choice vs. medical condition) on motivational regulations for PA (see Table 3). Both intrinsic (0.30) and integrated (0.19) regulations showed a small effect such that individuals who chose to live a GFD were more likely to endorse these regulations. Few other meaningful differences emerged with respect to behavioural regulations for PA between groups.

**Main Analysis: Relationship between motivational regulations for consuming a GFD diet and adherence**

Assumptions associated with multiple regression analyses were first examined to determine adherence. Skewness and kurtosis values demonstrated some departure from normality. However some deviation is acceptable (Mardia, 1971). Specifically, introjected (1.26) and external (1.27) regulations had a slightly positive skew while identified (-1.05) had a slightly negative skew. Meanwhile, introjected was the only regulation to be slightly leptokurtic (1.08). Bivariate correlations (see Table 4) were run to look at the relationship between the 2-item adherence measure and motivational regulations for eating a GFD ranged from $r_{12}$ = -.15 to .07. Correlations between REBS

subscale scores, ranged from $r_{12}$ = .22 to .65. Scatterplots were run to test the assumption of linearity. The assumption was met as the scatterplots, with a forced line of best fit, generally formed a football shape (Keppel & Zedeck, 1989).

The multiple regression model predicting participants' 2-item GFD adherence scores from motivational regulations spanning the OIT for dietary adherence was statistically significant ($F(5,196) = 2.36$, $p = .04$). Mahalanobis Distance values were then used to delete two outliers (MAH $\geq$ 20.52). Residual scores were found to be independent (i.e., Durbin Watson values< 12.01). Eight additional cases were removed as they were deemed to be extreme outliers based on standardized residuals less than -2 or greater than +2 (Field, 2012).

A final regression model was run ($n$ = 192; see Table 6), and again a significant prediction equation was noted between motives and the 2-item dietary adherence scores ($F(5,186) = 3.07$, $p = .01$). The REBS predictor values accounted for 5.00% of the 2-item GFD adherence variance ($R^2 = .08$, $R^2_{adj} = .05$) and a moderate effect size (Cohen's $\eta^2$ = .08; Cohen, 1988). Inspection of the standardized regression coefficients indicated that integrated ($\beta = -.32$, $p = .00$) and identified ($\beta = .30$, $p = .00$) regulations significantly predicted 2-item GFD adherence scores amongst the participants albeit the direction differed by predictor. Integrated and identified regulations were moderately correlated (see Table 4), so to remove the influence of these associations structure coefficients were calculated and interpreted. The structure coefficient for integrated regulation (-.53) was stronger than the structure coefficient for identified regulation (.24), which suggests integrated regulation has a stronger association with GFD adherence than identified regulation.

**Main Analysis: Relationship between motivational regulations for PA and LTEQ scores**

Assumptions associated with multiple regression analyses were first examined. Skewness and kurtosis values demonstrated some departure from normality, but some deviation is acceptable (Mardia, 1971). Specifically, external regulation was slightly positively skewed (1.84) and leptokurtic (3.36), while integrated regulation was slightly platykurtic (-1.09). Bivariate correlations (see Table 5) were run to look at the relationship between LTEQ scores and motivational regulations for PA and ranged from $r_{12}$ = -.15 to .54. Correlations between BREQ-2R subscale scores, ranged from $r_{12}$ = -.19 to .85. Scatterplots were then run again to test the assumption of linearity between motivational regulations for PA and LTEQ scores. The assumption was met as the scatterplots, with a forced line of best fit, generally formed a football shape (Keppel & Zedeck, 1989).

LTEQ outliers ($z$ = >|3.00|; $n$ = 5) were removed from the analysis. Mahalanobis Distance values identified no outliers (MAH $\geq$20.52) and as such no additional participants were removed based on this analysis. Residual scores were found to be independent based on Durbin Watson values (< 12.01). The multiple regression model predicting the participants' LTEQ scores from motivational regulations spanning the OIT for PA (see Table 7) was statistically significant ($F$(5,195) = 6.06, $p$ = .00). This regression analysis identified 13 additional cases that could be removed due to them being extreme outliers based on standardized residuals less than -2 or greater than +2 (Field, 2012). This resulted in a final sample size ($n$ = 183) from which motives for PA were regressed on LTEQ scores.

A significant prediction between motives and LTEQ scores ($F(5,177) = 17.22$, $p = .00$) was found. The BREQ-2R predictor values accounted for 31.00% of the variance in LTEQ scores ($R^2 = .33$, $R^2_{adj} = .31$) and a large effect size (Cohen's $\eta^2 = .33$; Cohen, 1988). Inspection of the standardized regression coefficients indicated that intrinsic ($\beta = .28$, $p = .01$) and identified ($\beta = .28$, $p = .04$) regulations significantly predicted LTEQ scores amongst the participants. Pearson bivariate correlations for intrinsic, integrated and identified regulations show that all three of these motives are highly correlated. Due to this high correlation, structure coefficients were calculated to determine a more direct effect. The structure coefficient's for intrinsic (.94), integrated (.86) and identified (.93) when interpreted, all had a strong association with PA behaviour.

## Chapter 4: Discussion

Living on a GFD is becoming more common (Canadian Digestive Health Foundation, 2014; Niewinski, 2008) with current estimates suggesting that approximately 4.3 million Canadians have eliminated or reduced gluten from their diet (Heydon, 2013). Additionally, choosing to consume a GFD, in the absence of a medical diagnosis, has become an increasingly popular nutritional strategy as one-third of American adults are trying to cut gluten from their diet (Consumer Reports, 2014). The severity of symptoms linked to gluten consumption, its prevalence and chronic nature has led to calls for increased research into its etiology, prevention, and management (Canadian Digestive Health Foundation, 2014; Health Canada, 2012). This study contributes to our understanding of the literature in the following ways. First, this study examined the relationship between theoretically-driven behavioural regulations for consuming a GFD and adherence. Second, differences in behavioural regulations between those who are medically advised to avoid gluten and those who do so by choice were investigated. Finally, results of this study offered novel insight into the level of PA engaged in by those living on a GFD and their corresponding behavioural regulations. This research has demonstrated differences between individuals who consume a GFD for medical reasons than by choice, that some motives linked with OIT do predict these lifestyle behaviours, and that PA in this cohort is different than the norms expressed by other subgroups of society. Therefore, the findings of this study add to the existing literature and offer possible insights for those working with individuals currently living a gluten-free lifestyle.

Given the sampling strategy adopted in this investigation, links to known demographic factors of those living on a GFD based on epidemiological data were made. Firstly, the majority of the sample was female (92%), which is similar to what is found in the existing Canadian and US-based research (Cranney et al., 2007; DiGiacomo, Tennyson, Green, & Demmer, 2013; Rubio-Tapia, Ludvigsson, Brantner, Murray, & Everhart, 2012). Secondly, the majority of the current sample self-identified as being Caucasian (96%), which is also consistent with the literature (Choung et al., 2015; Riddle, Murray, & Porter, 2012; Rubio-Tapia et al., 2012). When considering level of educational attainment, the Canadian Celiac Health Survey found that 69% of the CD sample ($n$ = 5240) had completed some post-secondary education (Cranney et al., 2007), which is considerably less than what was found in the current study (90.1%). In addition to having a larger percentage of individuals with some post-secondary education, the current sample measured education based on degree/diploma completion, which may suggest an even greater discrepancy from the Canadian norms. When looking at the relationship between PA and GFD adherence, bivariate correlations revealed that these two lifestyle behaviours do not correlate, which is inconsistent with existing literature (Tavares, 2014). Finally, the sample used in this study had a mean age of 42.35 years, which is similar to what is found in the literature. The Canadian Celiac Health Survey found their sample to have a mean age of 56 years (Cranney et al., 2007), while the National Health and Nutrition Examination Survey for the US found their participants to have a mean age of 45 (Rubio-Tapia et al. 2012). Overall, through these demographic variables, participants in the current study seem to be a good representation of the

existing CD population that has been studied with educational attainment being the only discrepant variable.

**Gluten-Free Dietary Adherence**

For those with gluten sensitivity, eliminating gluten from the diet is vital to an individuals' health (Cosnes et al., 2008; Dowd et al., 2013; Niewinski, 2008). However, a commitment to a GFD is not always achieved. A wide range of variability in adherence to a GFD, with rates ranging from 42% to 91% has been reported in previous studies, (Hall et al., 2009; Lanzini et al., 2009; Leffler et al., 2009; Leffler et al., 2008; Niewinski, 2008) and there is a need for greater insight into why individuals are non-adherent (Hall et al., 2009). Guided by findings reported by Dowd et al. (2013), it was hypothesized that approximately three-quarters of the participants in this study would adhere to their medically advised diet. As approximately three-quarters (74.7%) of the participants who consumed a GFD due to medical advisement adhered to a strict GFD over the previous week, hypothesis 1 is supported. This differed substantially from adherence rates reported by those who consume a GFD by choice (i.e., 56.5%). Of the non-adherers in this study, more accidental (24.3%) than purposeful gluten consumption (6.9%) was reported, which is also supported through existing research (Hall et al., 2013). Again, when comparing to results from Dowd et al. (2013), accidental gluten consumption (37.5%) and purposeful gluten consumption (7.6%) were similar to what was found in the current study. When referring to existent literature, adherence rates reported for this study may be linked to the degree of perceived severity of gluten intolerance (Hall et al., 2013). These findings could be due to the majority of the study's participant's being diagnosed with CD, and that participants who are medically advised to consume a GFD

are more likely to adhere than someone who does so by choice. Also, since CD is the only autoimmune condition on the gluten-free spectrum (Lammers et al., 2014; Ludvigsson et al., 2014), making the consequences of consuming gluten more severe, participants may show better adherence.

**PA compared to Normative Values**

Little is known about PA in individuals who consume a GFD (Passananti et al., 2013). Based on Passananti et al. (2013), hypothesis 2 was formed, which stated there would be no difference between the PA as reported by study participants and normative values. In the current study, the sample participated in significantly more PA on an average week than published normative values (Godin & Shephard, 1985; Wilson et al., 2010), which deems hypothesis 2 inaccurate. Based on the interpretation of these results, it can be suggested that people who live on a GFD are more likely to participate in higher amounts of PA across an average week. Reasons for this difference are purely speculative but may be guided by Tavares (2014) who commented that people who are active tend to engage in other healthy behaviours. As these behaviours may cluster together, it is suggestive that those who consume a GFD may also be healthier across a variety of other lifestyle markers including PA levels.

**Motivational Differences between Study Groups**

**Living on a GFD.** Currently our understanding of differences between the motives that underpin decisions to consume a GFD between those who are medically advised and those who do so by choice are limited. As such, no difference between these groups in motives for consuming a GFD was hypothesized. It was found that those who live on a GFD by choice endorsed reasons linked to enjoyment and satisfaction (i.e.,

intrinsic motives) to a slightly greater extent, in comparison to those who do so because of medical advisement. This makes intuitive sense as the 'by choice' group has the autonomy to choose to live on a GFD because they are not forced to do so for medical reasons. Individuals who choose to consume a GFD could be more intrinsically motivated because they feel satisfied when living a gluten-free lifestyle and/or by the interest and enjoyment of learning to prepare gluten-free foods. Having the choice to eat gluten-free, makes the decision more integrated into the sense of self. A moderate difference was found between the groups on external regulation, whereby those with a medical condition in this study were more motivated to consume a GFD to acquire a reward or avoid negative consequences (Deci & Ryan, 2002), in comparison to the 'by choice' group. This finding makes intuitive sense as people who consume a GFD because of medical advisement may do so to avoid negative symptoms and harmful effects on their body associated with gluten ingestion. As such, they are guided by controlling forces, as eating this way is not as internalized, less autonomous and satisfies an external demand. This finding appears consistent with Deci and Ryan's (2002) suggesting that extrinsic motivation is linked to a separable outcome and/or for its instrumental value.

**PA.** A hypothesis of no difference between groups (i.e., medically advised, 'by choice') in motivational regulations for PA was also advanced given the lack of literature around this topic. However, participants who were medically advised to consume a GFD endorsed intrinsic and integrated regulations more strongly than those who did so by choice. Therefore, these participants chose to be physically active because of the pure enjoyment found in the activity and how it incorporates ones values and goals (Deci &

Ryan, 2002) to a greater extent than those who choose to consume a GFD. This again shows that perhaps this population is choosing to live a healthier lifestyle, for reasons that are more integrated into the sense of self (Deci & Ryan, 2002).

**Relationship between motives for eating and GFD adherence**

Partial support was found for the hypothesis that autonomous motives would predict dietary adherence in individuals living on a GFD. Consideration of the pattern of associations at the bivariate level demonstrates a pattern of negligible-to-weak relationships between motives and adherence to a GFD ($r_{12}$ = .02 to -.15) with only integrated regulation attaining statistical significance with the behavioural measure. Overall, motives consistent with OIT predicted approximately 5.00% of the variability in adherence to a GFD over the previous week which is comparable to that reported by Wilson et al. (2012a). More specifically, Wilson et al. (2012a) reported that 6.00% of the variance in daily fruit and vegetable intake was accounted for by the examination of identified and intrinsic regulations. Although identified and intrinsic regulations were not statistically significant in the present investigation, the structure coefficients suggest that there still may be an association with intake (Wilson et al., 2012). The discrepancy may be due to the smaller sample size used in this study ($N$ = 37) and/or the authors only assessing two autonomous motives.

Based on the regression model, the higher the level of integrated regulation the better participants reported adhering to a GFD over the previous week. Further, the higher the level of identified regulation the worse the participants' dietary adherence across the same seven day period. However, when interpreting structure coefficients, it becomes clear that integrated regulation has more of a link with GFD adherence.

Identified regulation has a smaller association on GFD adherence when looking at the magnitude of the structure coefficients. Bivariate correlations show that integrated and identified regulations are moderately correlated in this sample (.65), which could suggest that there is some overlap between these two motives, possibly making identified appear as a positive predictor because of statistical suppression (Courville & Thompson, 2001). These results are somewhat consistent with OIT and current research. Both integrated and identified are considered autonomous motives and therefore should predict behaviour in the same direction (Deci & Ryan, 2002), which is not the case based on the current findings when just looking at standardized beta weights and structure coefficients. Evidence suggests that there is an association between autonomous motivation and dietary intake (Austin, et al., 2013; Hagger et al., 2006; Rutten et al., 2014; Shaikh et al., 2008) and these motives should have a positive impact on long-term behaviour change in individuals who have chronic conditions (Austin et al., 2013; Austin et al., 2011). In their analytic strategy, these authors (Austin, et al., 2013; Hagger et al., 2006; Rutten et al., 2014; Shaikh et al., 2008) created a composite autonomous motivation construct by combining identified, integrated and intrinsic regulation subscales into one omnibus variable. In the current study, each of these regulations were assessed separately. In their recent work, Wilson et al. (2012b) noted differences in interpretation when composite variables were created as opposed to keeping each regulation separate when predicting PA behaviour. Although not tested in the existing dietary literature, it makes intuitive sense that the nature of the scoring protocol for REBS items may influence the conclusions advanced. The relationship between the endorsement of controlled motives

and eating behaviour has demonstrated no relationship (Shaikh et al., 2008), which is consistent with the results of the current study.

Another possible reason for the slightly discrepant findings linked to autonomous motives in the current study and existing literature may be the outcome variable of interest. The bulk of the existing dietary intake literature using OIT as a guiding framework examines the relationship between motives and healthy eating (e.g., fruit and vegetable consumption, healthy eating; Austin, et al., 2013; Hagger et al., 2006; Rutten et al., 2014; Shaikh et al., 2008; Pelletier et al., 2004; Pelletier & Dion, 2007). Meanwhile, the current study assessed a different behaviour (i.e., GFD adherence). This change in outcome variable could have impacted the results as eating gluten-free is not necessarily "healthy eating" (Sass, 2013). Gluten-free foods often contain more unhealthy calories (e.g., more sugar and fat etc.; Sass, 2013), which is why having a different outcome variable than the existing research could cause a discrepancy in the current study's findings.

Another possible reason advanced for the discrepancies between the current findings and existing literature specific to autonomous motives is that the GFD adherence link may be attributed to the instrument used to assess OIT constructs. Currently, there is no instrument available that measures motives for GFD adherence consistent with OIT (Deci & Ryan, 2002). Therefore, the instrument developed by Pelletier et al. (2004), was modified for the purposes of this study. This adaptation was deemed the best possible option given that the instrument has been used as a measure of healthy eating across the motivational continuum identified by OIT. The extent to which OIT-based items capture healthy eating as opposed to GFD adherence is unclear. However, inspection of

estimates of internal consistency suggests scores for introjected and integrated that are lower than typically reported in the literature (e.g., introjected (.85), integrated (.90); Pelletier et al., 2004). Consequently, this remains an avenue ripe for additional investigation and possibly instrument refinement.

**Relationship between motives and PA Behaviour**

Partial support was also noted for hypothesis 4 when looking at PA in individuals living on a GFD. Overall, BREQ-2R scores accounted for approximately 31.00% of the variance in PA behaviour. These findings are consistent with existing literature as they fall closer to the upper range (12.00 to 30.00%; Wilson et al., 2012b). Specifically, intrinsic and identified regulations were found to positively predict PA behaviour in this sample. Both intrinsic and identified regulations have a significant beta weight, as well as a larger structure coefficient based on its magnitude in comparison to the controlled motives. However, it becomes clear that integrated regulation also has a larger association with PA based on this motive having a larger structure coefficient. A likely reason for integrated regulation not showing a statistically significant beta weight is because of the high correlation noted with other autonomous motives suggestive of a suppressor effect. Overall, when looking at beta weights and structure coefficients, it becomes clear that more autonomous motives are positively linked with PA behaviour.

Researchers have found intrinsic (Brunet & Sabiston, 2011; Edmunds et al., 2006; Haerens et al., 2010), integrated (Duncan et al., 2010; Wilson et al., 2004) and identified (Brunet & Sabiston, 2011; Haerens et al., 2010; Wilson et al., 2012b; Wilson et al., 2008; Wilson et al., 2004) regulations to be significant predictors of PA behaviour. This means that the more these participants felt pure enjoyment, felt that PA was aligned with their

values and felt personal importance towards PA (Deci & Ryan, 2002), the more active they were. Additionally, introjected regulation did not predict PA behaviour consistent with existing literature (Edmunds et al., 2006; Haerens et al., 2010). Finally, it has been stated in the literature that external regulation can be a non-significant predictor to PA behaviour (Haerens et al., 2010), which is what was found in the current study.

**Limitations**

There are a number of limitations that could have influenced the results of this study. Firstly, the cross-sectional study design of the current research precludes causal implications. The design of this study was thoughtfully chosen given the data collection methods (i.e., internet recruitment), which renders the feasibility of testing participants over time more challenging. Trochim (2001) indicates that conclusions about the nature of relationships between study variables can be made from cross-sectional data. Care has been taken to ensure conclusions do not over-extend what is appropriate given the design of this research study. However, the accuracy of the results were limited as change over time is not being assessed; therefore the results should be interpreted with caution.

Secondly, an additional limitation that surrounds this study design is the exclusive use of self-report data. Crocker and Algina (1986) suggest there are a number of possible issues with self-report data, including misunderstanding items, social desirability, and recall bias. Understandably, more objective measures for measuring GFD adherence (e.g., biopsy; Green & Cellier, 2007; Health Canada, 2012; Lammers et al., 2014) and PA (e.g., SenseWear Armband; BodyMedia, 2013) were recognized as beneficial, but these methods were less feasible given that recruitment was online. Therefore, although

gathering data only through self-report could have influenced the accuracy of the results, this method was attainable given the online nature of the study.

Thirdly, the inclusion/exclusion criteria could also be identified as a limitation. Throughout recruitment there was interest from people outside of the age group specified for this study. As CD can manifest itself at any age (Cranney et al., 2007; Green & Cellier, 2007; Health Canada, 2012; Lammers et al., 2014; Ludvigsson et al., 2014), incorporating participants outside of the adult age group may have be beneficial to study results. Additionally, the survey was only offered online and in order to participate, each participant needed to have access to a computer. This criterion could have influenced individuals not to participate if this was not easy access or if they preferred to complete the survey on a hard-copy. On the contrary, individuals who agree/consent to participate may also be more invested or interested in the study topic, which in turn could make them more autonomously motivated to participate. Participants could then be more predisposed to respond higher to autonomous motives for both the REBS and the BREQ-2R.

Fourthly, this study had largely unequal group sizes. There were significantly more medically advised participants, mainly being diagnosed with CD, than participants who were living on a GFD by choice. The majority of the participants came from CD support groups as they showed the most interest, which in turn, influenced the sample sizes. In order to get a more equal representation of this population, more participants in the other conditions would have been beneficial. This could be done by doing less recruitment from CD support groups. However, efforts were made to account for this

limitation as recruitment was extended to individuals outside of Canada to gain a greater variety of participants.

Finally, the lack of instrumentation available in the current research to assess motives consistent with OIT and gluten-free dietary adherence could have influenced the results. One tool was used to collect GFD adherence, and it was based over the previous week. If participants completed the survey early on, the "previous week" could have been over the holidays, which could impact the results. Perhaps having an instrument that assessed dietary adherence over a longer time-frame would have been beneficial. Additionally, a modified version of the REBS was used to assess motives for GFD adherence, which could have not been an accurate representation for these variables. The REBS had not been modified in this way before and the validity and reliability of test scores has not been previously tested given the published literature. However, there is currently no instrument available to assess these variables in the literature, so the modified REBS was the best available option at the time of the data collection for this study. A recommendation for moving forward is to consider instrument development for GFD adherence consistent with OIT, where the instrument could be tested in a pilot study prior to implementation in a larger research project.

**Future Implications**

Since the current investigation was novel and timely, there are a number of opportunities for future research. First, future research could target individuals who were excluded from this study (e.g., fell outside of the age-group). As little research exists around this topic, looking at different populations would be beneficial to further enhancing findings. Also, since the groups were not equal in this study, the groups that

were underrepresented (e.g., consuming a GFD 'by choice') could be targeted. Second, a similar study could be run, but assessed at a different time-point or multiple time-points to assess changes overtime that occur between motives and behaviour. This longitudinal change in design could add to the findings of the current study and offer slightly greater insight into causality. Third, offering the opportunity for participants to include open-ended comments may elucidate additional insight into the reasons why participants are motivated to consume a GFD. Fourth, creating/modifying new instruments targeting motives to consume a GFD consistent with the OIT (Deci & Ryan, 2002) may be beneficial. Formative research or think-aloud procedures may be useful in the future to examine the extent to which the REBS taps into motives for consuming a GFD. As the percent variance for the modified REBS leaves approximately 95% of GFD adherence not accounted for additional instrument development is warranted. Finally, it remains unclear whether PA helps or hinders intestinal health (Barella, 2008; Niewinski, 2008), so future research investigating PA in this population would ultimately be useful. Measuring intestinal health could be done through biopsy (Green & Cellier, 2007; Health Canada 2012; Lammers et al., 2014), while PA could be measured with technology-based monitors (e.g., SenseWear Armband; BodyMedia, 2013) or self-report (LTEQ; Godin & Shephard, 1985). Researchers have given merit to the idea that health behaviours can influence each other (Wilson et al., 2014), so having a greater understanding of PA could be beneficial to understanding this cohort. Overall, further investigation into these variables in this population will help to reduce the gaps in the literature.

### Practical Implications

Interpreting these findings in a practical sense, leads to a number of future directions. First, current findings should be considered in developing future interventions with an aim of encouraging a healthier lifestyle in this cohort. The development of interventions to improve gluten-free dietary adherence or research in general is a major goal (Sainsbury et al., 2013), which needs to be addressed through continued research. Health professionals could center future interventions for GFD adherence around more autonomous motives, specifically integrated regulation. If these professionals' help individuals feel as though adhering to a GFD would be aligned with their values and goals, these individuals may show better adherence. Second, current findings could be used by health professionals to motivate this cohort to be physically active, where again interventions targeting autonomous motives (i.e., intrinsic, integrated and identified regulations) could be beneficial in getting this group more active. This would mean aligning future intervention attempts with the intention for individuals to feel enjoyment, feel like the behaviour is consistent with their goals and values and finally, feeling that the behaviour has personal importance. Overall, further research in this field will ultimately help with understanding this population with hopes of increasing their overall health.

## Conclusion

Overall, the present study addresses multiple gaps in the literature by providing unique insight into individuals living on a GFD. Understanding how well these individuals adhere to their diet, how physically active they are and what motivates them to participate in these lifestyle behaviours, is important information to acquire in order to

influence future research and intervention. The main results of this study shed insight on this population. It was found that approximately three-quarters of the sample adhered to a strict GFD, and that these participants are more active than published normative data. Additionally, it was determined that individuals who consume a GFD by choice are motivated for more autonomous reasons (i.e., intrinsic regulation) to adhere to their diet than individuals who do so because they are medically advised. Meanwhile, individuals who are medically advised to consume a GFD are more motivated for controlled reasons (i.e., external regulation) than the 'by choice' group. Individuals who chose to live a GFD were also more likely to be autonomously motivated (i.e., intrinsic and integrated regulations) to participate in PA. Finally there were significant predictive links found between motives and both gluten-free dietary adherence (i.e., integrated and identified regulations) and PA (i.e., intrinsic and identified regulations). While there can be little doubt of the contribution of this study to the existing literature, study limitations are noted which offer insight into future directions and practical implications. Researchers interested in studying individuals living on a GFD are encouraged to consider recommendations advanced when designing their study.

## Footnotes

[1]We assumed that the participants in the medically advised group (i.e., CD, a Wheat Allergy and Non-Celiac Gluten Intolerance) were actually instructed to eat gluten-free due to advisement from a physician.

[2]Kurtosis values for amotivation for the present sample were 21.50.

[3]Originally a MANOVA was planned to test hypothesis 3, but the sample size of those who were living on a GFD by choice was smaller than recommended (VanVoorhis & Morgan, 2007). As such, an alternate means through which to test this hypothesis was adopted.

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# Appendices

## Appendix A: Ethics Clearance Certificate

Brock University
Research Ethics Office
Tel: 905-688-5550 ext. 3035
Email: reb@brocku.ca

Bioscience Research
Ethics Board

### Certificate of Ethics Clearance for Human Participant Research

| | | | |
|---|---|---|---|
| DATE: | 1/7/2015 | | |
| PRINCIPAL INVESTIGATOR: | MACK, Diane - Kinesiology | | |
| FILE: | 14-099 – MACK | | |
| TYPE: | Masters Thesis/Project | STUDENT: | Amy Crawford |
| | | SUPERVISOR: | Diane Mack |

TITLE: A Life without Wheat: Dietary Adherence, Physical Activity, and Motives

**ETHICS CLEARANCE GRANTED**

Type of Clearance: NEW Expiry Date: 1/29/2016

The Brock University Bioscience Research Ethics Board has reviewed the above named research proposal and considers the procedures, as described by the applicant, to conform to the University's ethical standards and the Tri-Council Policy Statement. Clearance granted from **1/7/2015** to **1/29/2016**.

The Tri-Council Policy Statement requires that ongoing research be monitored by, at a minimum, an annual report. Should your project extend beyond the expiry date, you are required to submit a Renewal form before
1/29/2016. Continued clearance is contingent on timely submission of reports.

To comply with the Tri-Council Policy Statement, you must also submit a final report upon completion of your project. All report forms can be found on the Research Ethics web page at http://www.brocku.ca/research/policies-and-forms/research-forms.

In addition, throughout your research, you must report promptly to the REB:

a) Changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
b) All adverse and/or unanticipated experiences or events that may have real or potential unfavourable implications for participants;
c) New information that may adversely affect the safety of the participants or the conduct of the study;
d) Any changes in your source of funding or new funding to a previously unfunded project.

We wish you success with your research.

Approved:

Brian Roy, Chair
Bioscience Research Ethics Board

**Note:** Brock University is accountable for the research carried out in its own jurisdiction or under its auspices and may refuse certain research even though the REB has found it ethically acceptable.

If research participants are in the care of a health facility, at a school, or other institution or community organization, it is the responsibility of the Principal Investigator to ensure that the ethical guidelines and clearance of those facilities or institutions are obtained and filed with the REB prior to the initiation of research at that site.

Appendix B: Sample of Recruitment Poster

# RESEARCH PROJECT

*A Life without Wheat: Dietary Adherence, Physical Activity and Motives*

## Are you living on a Gluten-Free Diet?

**Purpose:** The purpose of this research study is to look at dietary adherence and physical activity in individuals living on a gluten-free diet. The reasons for engagement in these lifestyle behaviours are also examined.

**Study Requirements:** Participation will take approximately 15 minutes to complete an online questionnaire.

**Eligibility:** We are interested in your thoughts if you a) are currently living on a gluten-free diet, (b) have consented to participate, (c) between the ages of 18-64, (d) able to understand and speak English, (e) willing to complete a series of questionnaires and, (f) have access to both a computer and Internet.

***Help us learn more about the gluten-free lifestyle!***

This study has been approved by the REB at Brock University (File #14-099)

**BROCK UNIVERSITY**

**FACULTY OF APPLIED HEAKTH SCIENCES**

***Graduate Studies***

**For more information please contact:**

**Amy M. Crawford, BKin** (ac09nn@brocku.ca)

**Diane E. Mack PhD** (dmack@brocku.ca)

## Appendix C: Verbal Presentation Script

This is the verbal script that will be used to recruit participants through in-class presentations in both undergraduate and graduate classrooms.

Good Morning/Afternoon/Evening,

My name is <*insert researcher name here*> and I am a Masters Student in the Behavioural Health Sciences Research Lab in the Faculty of Applied Health Sciences at Brock University. I am here to present to you a research project we are currently working on. Are you currently living on a gluten-free diet? If so, this study may be of interest to you. The purpose of this research study entitled "A Life without Wheat: Dietary Adherence, Physical Activity and Motives", is to look at individuals living on a gluten-free diet, their dietary adherence, physical activity levels and the reasons why they engage in these lifestyle behaviours. To participate in this study you must be: (a) self-identified as living on a gluten-free diet, (b) have consented to participate, (c) between the ages of 18-64, (d) must be able to understand and speak English, (e) willing to complete a series of questionnaires and, (f) must have access to both a computer and Internet. No physical survey is being delivered or offered. Your participation is voluntary and all of the information that you provide will remain confidential which means that we will not be sharing your personal information with any other person or party in such a manner that you could be identified as a consequence of participating in this project.

This study involves responding to a series of online questionnaires kept on a secured site that will take approximately 15 minutes. If you are interested in taking part in this study, we are currently recruiting participants.

If you are enrolled in academic classes at Brock University, participation/non-participation will not affect your academic standing. Please see/contact Amy Crawford at ac09nn@brocku.ca or Dr. Diane Mack at dmack@brocku.ca if you would like to discuss the study more privately or if you would like our contact information.

Thank you for your time. If you have any questions regarding our research program at Brock University or this research project in particular, please feel free to contact me and I would be happy to answer any questions you have.

## Appendix D: Social Media Study Announcement

Are you currently living on a gluten-free diet? If so, this study may be of interest to you.

My name is Amy Crawford and I am a Masters Student in the Behavioural Health Sciences Research Lab in the Faculty of Applied Health Sciences at Brock University. The purpose of this research study entitled "A Life without Wheat: Dietary Adherence, Physical Activity and Motives", is to look at individuals living on a gluten-free diet, their dietary adherence, physical activity levels and the reasons why they engage in these lifestyle behaviours. To participate in this study you must be: (a) self-identified as living on a gluten-free diet, (b) have consented to participate, (c) between the ages of 18-64, (d) must be able to understand and speak English, (e) willing to complete a series of questionnaires and, (f) must have access to both a computer and Internet. No physical survey is being delivered or offered. Your participation is voluntary and all of the information that you provide will remain confidential which means that we will not be sharing your personal information with any other person or party in such a manner that you could be identified as a consequence of participating in this project.

This study involves responding to a series of online questionnaires on a secured site that will take approximately 15 minutes of your time. If you are interested in taking part in this study, we are currently recruiting participants. Your privacy and confidentiality will be compromised if you interact with this page while signed in or if you comment/post on this page.

If you are enrolled in academic classes at Brock University, participation/non-participation will not affect your academic standing. Please contact Amy Crawford at ac09nn@brocku.ca or Dr. Diane Mack at dmack@brocku.ca if you are interested and would like more information.

The study has been reviewed and has received ethics clearance through the Bioscience Research Ethics Board at Brock University (FILE #:14-099).

Thank you for your time.

Appendix E: Recruitment Strategy

**Ontario:**

| Organization | Contact | Contact History |
|---|---|---|
| Belleville Celiac Group | Gerry Powell<br>dpowell@dryden.net<br>chapter.on.bellville.quinte@celiac.ca | • First contact January 12th, 2015<br>• Second contact Jan. 26th, 2015<br>• Final contact Feb 2nd, 2015 |
| Dundas – Hamilton/ Burlington Chapter | hamiltonceliacchapter@gmail.com<br>Laura Harrison, President<br>ljharrison013@gmail.com<br>Janice Harrison<br>j.a.harrison01@gmail.com | • First contact January 12th, 2015<br>• Laura replied January 13th, 2015 so I sent her the link Jan. 13th. She also offered to pass this information to the Hamilton Chapter.<br>• She mentioned that she has heard that all the presidents have received this email and that she is waiting on a response from Sue Newell.<br>---<br>• First contact January 12th, 2015<br>• Janice replied January 12th 2015 so I sent her the link Jan. 12th. She offered to send my information to the Hamilton chapter to send out an email blast. |
| Halton-Peel Chapter | maripet.haus@sympatico.ca | • First contact January 12th, 2015<br>• Marilyn Mahnke replied January 16th, 2015 saying she would be glad to share this information with her Chapter.<br>• I replied January 16th, 2015 with the survey link |

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| | | and more information.<br>• Marilyn responded with questions and I replied the same day Jan. 16th, 2015.<br>• On Jan, 17th she said my information would go out to the Halton Peel Chapter. |
| Kingston-Waterloo Chapter | info@kingstonceliac.ca<br>chapter.on.kingston@celiac.ca<br>kwceliac@sympatico.ca | • First contact January 12th, 2015<br>• Second contact Jan. 26th, 2015<br>• Final contact Feb 2nd, 2015<br>---<br>• First contact January 12th, 2015.<br>• Connie McNeil (kwceliac@sympatico.ca ) replied January 14th, 2015.<br>• I sent her the link January 14th, 2015 and she agreed to share it with other members of their organization. |
| Kitchener-Waterloo Chapter | Sue Newell<br>sue.newell@sympatico.ca | • First contact January 12th, 2015<br>• Sue Newell replied January 14th, 2015. She said she could include my survey in the monthly newsletter sent out on the 15th and on their Facebook group.<br>• I responded January 14, 2015 with more information and the survey link. |
| National Office: Canadian Celiac Association | info@celiac.ca | • First contact January 12th, 2015<br>• Second contact January 26th, 2015<br>• Final contact Feb 2nd, |

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|---|---|---|
| | | 2015 |
| Ottawa Chapter | chapter.on.ottawa@celiac.ca | • First contact January 12th, 2015<br>• Second contact Jan. 26th, 2015<br>• Final contact Feb 2nd, 2015 |
| Peterborough Chapter | laurie.bovair@sympatico.ca<br>chapter.on.peterborough@celiac.ca | • First contact January 12th, 2015<br>• Second contact Jan. 26th, 2015<br>• Final contact Feb 2nd, 2015 |
| Sarnia-Lambton Celiac Group | John Visser<br>jvisser@ebtech.net | • First contact January 12th, 2015<br>• Invalid email address (looked for new contact) |
| St. Catharines Chapter | Lynne Turcotte (President)<br>lturcotte@cogeco.ca<br>Colleen Smith, Vice President<br>chapter.on.st.catharines.pres@celiac.ca | • First contact January 12th, 2015 (both)<br>• Cathy Cretney, the president of the St. Catharines Chapter, replied January 19th asking if I can come and speak to their group at their next meeting (February 10th).<br>• I responded January 20th saying yes.<br>• Cathy replied January 20th giving me more details and asking if I can bring hard copies of the survey. I will ask Diane at our meeting January 22nd and then respond to Cathy.<br>• Did not end up bringing hardcopies but still went to meeting Feb 10th |
| Thunder Bay Celiac Group | Judy Gardner<br>kdolph@nwconx.net<br>chapter.on.thunderbay@celiac.ca | • First contact January 12th, 2015<br>• Second Contact Jan. 26th, 2015 |

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|---|---|---|
| | | • Final contact Feb 2nd, 2015 |
| Toronto Chapter | Marilyn McCool<br>mccool@interlog.com<br>Naeem Saleh<br>naeem@inforamp.net<br>chapter.on.toronto@celiac.ca | • First contact January 12th, 2015<br>• Second contact Jan. 26th, 2015<br>• Final contact Feb 2nd, 2015<br>---<br>• First contact January 12th, 2015<br>• Alison Cazalet (chapter.on.toronto@celiac.ca) replied January 15th, 2015 willing to share my information in their email blasts, website and Facebook page.<br>• I responded January 16th with more information and survey link.<br>• Alison replied Jan 22nd saying that the survey link has been sent out to their members via email (about 390 people) and posted it on their Facebook page. She also said they will get it on their website in the next few days.<br>• She also asked If I would be interested in presenting my results when they are finalized. I said I would like that. |
| Windsor Celiac Foundation | Rachel Blanchard,<br>rachelblanchardo@gmail.com<br>windsorceliac@hotmail.com | • First Contact January 16th, 2015<br>• Second contact Jan. 30th, 2015<br>• (windsorceliac@hotmail.com) failed |

| | | |
|---|---|---|
| | | • Final contact Feb 6th |

**Provinces in Canada outside of Ontario:**

| Organization | Contact | Contact History |
|---|---|---|
| Calgary, **Alberta** | info@calgaryceliac.ca | • First Contact January 16th, 2015<br>• Linda Cooper replied Jan 16th, 2015 wanted more information and willing to put my information on their website and newsletter (March)<br>• I replied Jan. 19th with more information and the survey link.<br>• Linda then responded on January 21st saying my information and link was now up on their website. They also wanted a closing date, so I replied the same day. |
| Edmonton, **Alberta** | info@celiacedmonton.ca | • First Contact January 16th, 2015<br>• Kathy Hurley replied Jan. 19th, 2015 saying that she forwarded my email to their Chapter President an Deborah Rayment their Program Coordinator for their attention. |
| Edmonton , **Alberta** Chapter | Joan Tuckey<br>jtuckey@shaw.ca<br>Cindy Tetz<br>ctetz@telusplanet.net | • First Contact January 16th, 2015<br>• Both email addresses were invalid |
| Celiac Groups in **British Columbia** | **Kelowna Celiac Group**<br>Dianne Steeper:<br>Bruce_Steeper@bc.sympatico.ca<br>Susan Carmack | • First Contact January 16th, 2015<br>• All email addresses were invalid |

| | | |
|---|---|---|
| | susan@carmack.ca<br>Dorothy Hilde<br>dhilde@awinc.com<br><br>**Vancouver Celiac Group**<br>info@vancouverceliac.ca<br><br>**Victoria Celiac Group**<br>Mike Rose<br>mike_rose@BC.sympatico.ca | |
| Kamloops, **B.C.** | chapter.bc.kamloops@celiac.ca | • First Contact January 16th, 2015<br>• Second contact Jan. 30th, 2015<br>• Final contact Feb 6th, 2015 |
| Kelowna, **B.C.** | chapter.bc.kelowna@celiac.ca | • First Contact January 16th, 2015<br>• Second contact Jan. 30th, 2015<br>• Final contact Feb 6th, 2015 |
| Vancouver, **B.C.** | info@vancouverceliac.ca | • First Contact January 16th, 2015<br>• Sarah Makepeace replied on Jan. 16th saying they were interested but needed more information to show the board.<br>• I replied with more information Jan. 17th<br>• Sarah forward my information to National, once she hears from them she will let me know (Jan 29th) |
| Victoria, **B.C.** | victoriaceliacs@hotmail.ca | • First Contact January 16th, 2015<br>• Second contact Jan. |

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|---|---|---|
| | | 30th, 2015<br>• Final attempt Feb. 6th, 2015 |
| Celiac Groups in **Manitoba** | **Winnipeg Celiac Group**<br>Pat Sparling<br>office@celiac.mb.ca | • First Contact January 16th, 2015<br>• Email was invalid |
| **Manitoba** | office@manitobaceliac.com<br>chapter.mb.westernmanitoba.ca@celiac.ca | • First Contact January 16th, 2015<br>• Dorothy Macintyre, president of Manitoba chapter replied Jan. 18th saying they would like to put my information up on their website.<br>• I responded Jan. 19th with more information and the survey link. |
| Celiac Groups in **New Brunswick** | **Fredericton Celiac Group**<br>Sandra McNeilly<br>rmcneill@fundy.net | • First Contact January 16th, 2015<br>• Email address was invalid |
| Saint John, **New Brunswick** | chapter.nb.saintjohn@celiac.ca | • First Contact January 16th, 2015<br>• Lisa Dooley, president of the St. John's Chapter agreed to send it out through email to their membership (Jan. 18th)<br>• I replied Jan 19th with more information and the survey link. |
| Fredericton, **New Brunswick** | fred.celiac@gmail.com | • First Contact January 16th, 2015<br>• Second contact Jan. 30th, 2015<br>• Final contact Feb. 6th |
| Moncton, **New Brunswick** | chapter.nb.moncton@celiac.ca | • First Contact January 16th, 2015 |

| | | |
|---|---|---|
| | | • Second contact Jan. 30th, 2015<br>• Final contact Feb 6th |
| **Newfoundland** & Labrador | chapter.nf.lab@celiac.ca | • First Contact January 16th, 2015<br>• Second contact Jan. 30th, 2015<br>• Final contact Feb. 6th, 2015 |
| Celiac Groups in **Nova Scotia** | **Halifax Celiac Group**<br>celiac.halifax@ns.sympatico.ca | • First Contact January 16th, 2015<br>• Second contact Jan. 30th, 2015<br>• Final contact Feb 6th, 2015 |
| **Nova Scotia** | info@celiacns.ca | • First Contact January 16th, 2015<br>• Second contact Jan. 30th, 2015<br>• Final contact Feb. 6th, 2015 |
| **Prince Edward Island** | info@celiacpei.ca | • First Contact January 16th, 2015<br>• Second contact Jan. 30th, 2015<br>• Final contact Feb. 6th, 2015 |
| Celiac Groups in **Quebec** | Mireille Cyr<br>florence@globetrotter.qc.ca | • First Contact January 16th, 2015<br>• Second contact Jan. 30th, 2015<br>• Final contact Feb 6th, 2015 |
| **Quebec** | info@celiacquebec.ca | • First Contact January 16th, 2015<br>• Second contact Jan. 30th, 2015<br>• Final contact Feb. 6th, 2015 |
| Celiac Groups in **Saskatchewan** | **Saskatoon Celiac Association**<br>Barbara-Ann deHaan<br>saskatoonceliacassociation@g | • First Contact January 16th, 2015<br>• Second contact Jan. 30th, 2015 |

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|---|---|---|
| | mail.com | • Final contact Feb. 6th, 2015 |
| Saskatoon, **Saskatchewan** | chapter.sk.saskatoon@celiac.ca | • First Contact January 16th, 2015<br>• Penny (emmaj@sasktel.net) responded Jan. 16th 2015 saying that she would pass it along to their membership<br>• I responded January 17th with more information and the survey link<br>• She responded on Jan. 18th asking for a pdf file which I sent to her Jan. 19th |
| Regina, **Saskatchewan** | chapter.sk.regina@celiac.ca | • First Contact January 16th, 2015<br>• Second contact Jan 30th, 2015<br>• Final contact Feb 6th |
| Celiac Groups in **Yukon** | **Whitehorse**<br>Leona Marinoske<br>leonayukon@yahoo.com | • First Contact January 16th, 2015<br>• Invalid email address |
| **Yukon** Territory (part of the Edmonton CCA Chapter) | ccayukon@gmail.com | • First Contact January 16th, 2015<br>• Barb replied Jan 17th wanted to participate herself.<br>• I sent more information and survey link on Jan. 19th. Also asking her to pass the information on if possible. |

**USA:**

| Organization | Contact | Contact History |
|---|---|---|
| Gluten Intolerance Group of North America | CustomerService@gluten.net | • First Contact January 21st |
| American Celiac Disease Alliance: Unified Voice for Celiac Disease (Formerly Celiac Task Force) | Andrea Levario info@Americanceliac.org | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| National Foundation for Celiac Awareness (Non-profit Organization) | Ambler info@CeliacCentral.org | • First Contact January 26th, 2015<br>• Cheryl McEvoy no longer works for this organization so new emails were given. Contacted Alicia Carango acarango@celiaccentral.org on Jan 26th, 2015 who is responsible for the website, newsletter, events and social media |
| Celiac Disease Foundation – National Celiac Disease Support Group | cdf@celiac.org | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Center for Celiac Research: University of Maryland Center for Celiac Research | pking@peds.umaryland.edu | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Birmingham - Support Group Birmingham Celiac Disease Support Group (Alabama) | Rebecca Kinney birminghamceliac@hotmail.com | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Los Angeles - Support Group: Awesome Friends | Harmony Hopkins awesomefriendsmeetup@gmail.com | • First Contact January 26th, 2015<br>• Second contact Feb 9th |

| | | |
|---|---|---|
| with Food Sensitivities | | • Final contact Feb 16th |
| Huntsville, AL North Alabama Gluten Intolerance Group | Jeana Swaim, President jswaim@arilion.com | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Arizona: Fountain Hills - Support Group | Allyn Krieger-Fiedler drakfiedler@cox.net | • First Contact January 26th, 2015<br>• Invalid Email |
| Arizona: Green Valley - Support Group | Kay Bleuer nkbleuer@yahoo.com | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Phoenix - Support Group<br>Celiac Support of Greater Phoenix (A CDF Connections Group) | Diane Lake dlake41@cox.net | • First Contact January 26th, 2015<br>• Invalid Email |
| Tucson - Support Group<br>Southern AZ Celiac Support | Cheryl Wilson rhranchaz@earthlink.net | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Little Rock - Support Group<br>Gluten Free in Central Arkansas | Anne Luther aaluther@comcast.net | • First Contact January 26th, 2015<br>• Invalid Email |
| California: Lake Arrowhead - Support Group | Jeanne Dickson gfjeanne@msn.com | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Modesto/Stockton /Turlock - Support Group<br>Central Valley Celiacs | Karen Cadiz centralvalleyceliacs@comcast.net | • First Contact January 26th, 2015<br>• Invalid email |
| Newport Beach - Support Group<br>Newport Beach Celiacs | Barbara Nielsen glutenfreecoach@cox.net | • First Contact January 26th, 2015<br>• Invalid email |
| Redding - Support Group:<br>The Redding Gluten Free | Misty Price mistyprice@charter.net | • First Contact January 26th, 2015<br>• Misty Prince responded Feb 5th saying that she |

| | | |
|---|---|---|
| Support Group | | sent my information out to the members of her group. |
| Santa Maria - Support Group<br>Santa Maria Celiac Support Group | Leona Meyer<br>info@smvceliac.com | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| San Diego Support Group<br>San Diego Celiac Sprue Association (CSA) | Glorian Beeson<br>frankbeeson@cox.net | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Denver - Support Group | Donna Steelman<br>donnasteelman@comcast.net | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Fort Collins - Support Group | Deborah Fusco<br>dfusco@hach.com | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| New Haven - Support Group | Bill Jacobs<br>wajacobs15@aol.com | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Suffield - Support Group<br>Celiac Discussion Group | Kathy Bosse<br>Kathybosse@aol.com | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Wilmington/Newark - Support Group<br>Delaware Celiac and Gluten Free Group | Eva Szalewicz<br>glutenfreedelaware@gmail.com | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Washington DC - Support Group<br>Washington Area Celiac Support Group | Susan Flinn<br>info@dcceliacs.org | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Clearwater - Support Group | Brian Kelly<br>bkelly1@tampabay.rr.com | • First Contact January 26th, 2015<br>• Brian Kelly responded Feb 5th asking for the survey link. |

| | | |
|---|---|---|
| Orlando - Support Group<br>Celiacs of Orlando | Michael Jones<br>mjones@digital.net. | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Atlanta - Support Group<br>GIG of Atlanta | Julie A Arnes – President<br>jennifer@gigofatlanta.com | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Chicago - Support Group<br>Southwest Suburban Celiac Support Group | Christine Sabbia<br>socwkr@hotmail.com | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Indianapolis - Support Group<br>Celiac Support Group of Indianapolis, | Joyce Etheridge<br>mjbetheridge@aol.com | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Kansas City - Support Group<br>Greater Kansas City Celiacs (CSA) | Helen Richards<br>richgary@swbell.net | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Louisville - Support Group<br>Greater Louisville (Kentucky) CSA Chapter | Emily McKinney<br>ecmckinney@gmail.com | • First Contact January 26th, 2015<br>• Emily replied Jan 26th saying that she was interested and will pass it along to their group. I sent the attachment to her Jan. 26th. |
| Portland - Support Group<br>Portland Maine Celiac/DH Support Group | info@csachapter88.com | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Boston - Support Group<br>(Greater Boston Celiac/DH Support Group, Chapter #67 of CSA/USA)<br>New England Celiac Organization | Lee Graham<br>randlgraham@comcast.net | • First Contact January 26th, 2015<br>• Lee Graham responded (Feb 9th) saying that I can put my information on their Facebook page |

| | | |
|---|---|---|
| Ann Arbor - Support Group Gluten Free Ann Arbor | Valerie Mates gfaa@unixmama.com | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Minneapolis/St. Paul Area Support Group Northland Celiac Support Group (formerly Midwest Gluten Intolerance Group) | Karen Geronime klgeronime@aol.com | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Celiac Sprue Association – Nation Celiac Disease Support Group | Mary Schluckebier Thomas Sullivan celiacs@csaceliacs.org | • First Contact January 26th, 2015<br>• Second contact Feb 9th<br>• Final contact Feb 16th |
| Celiac Community Foundation of Northern California | Jennifer Iscol - President jiscol@celiaccommunity.org campceliac@gmail.com | • First contact Feb 4th, 2015<br>• Jennifer Iscol responded Feb. 5th asking for more information. I responded Feb. 5th. |
| Lancaster Area Celiacs Support Group | CoLeaders: Niki Cartwright, Carrie Meyers & Sandy Stine lac-leader@lancasterareaceliacs.org | • First contact Feb 4th, 2015<br>• Second contact Feb18th<br>• Final contact Feb 25th |
| Gluten Intolerance Group of North America | Karylin Elroy karylin.elroy@gluten.net | • First contact Feb 4th, 2015<br>• Invalid email |
| Gluten Intolerance Group of North Alabama Huntsville | Shirley Holt holt@pclnet.net | • First contact Feb 4th, 2015<br>• Invalid email |
| Anchorage Gluten-free Support group, Alaska | Brandy Wendler brandywendler@gmail.com | • First contact Feb 4th, 2015<br>• Second contact Feb18th<br>• Final contact Feb 25th |
| AZ East Valley Celiac Disease Foundation | Chandice Probst azeastvalleysupportgroup @gmail.com | • First contact Feb 4th, 2015<br>• Second contact Feb18th |

| | | |
|---|---|---|
| Support Group, Gilbert Arizona | | • Final contact Feb 25th |
| Southern Arizona Celiac Support Group | Kim Pebley info@southernarizona celiacsupport.org | • First contact Feb 4th, 2015<br>• Invalid email |
| Celiac Sprue Association – Arkansas, Hot Springs Village Resource #92 | Rita Fordham rrhsv@cox.net | • First contact Feb 4th, 2015<br>• Invalid email |
| Gluten Free in Central Arkansas | Anne Luther aaluther@comcast.net | • Already emailed above<br>• Invalid email |
| Gluten Intolerance Group of Northwest Arkansas | Dana Ward danajeanward@gmail.com | • First contact Feb 4th, 2015<br>• Second contact Feb18th<br>• Final contact Feb 25th |
| Carlsbad – Resource: Celiac Support | Helen Foreman bhforeman@webtv.net | • First contact Feb 4th, 2015<br>• Invalid email |
| Gluten Intolerance Group of Marin | Samantha Barsky glutenfreemarin@yahoo.com | • First contact Feb 4th, 2015<br>• Invalid email |
| Resource Unit: Celiac Support, Merced | Gary L. Brackney Sr outsider@elite.net | • First contact Feb 4th, 2015<br>• Invalid email |
| Oakland Support Group – Celiac Disease Foundation | Melissa Batavia melbatavia@comcast.net | • First contact Feb 4th, 2015<br>• Invalid email |
| Orange County Celiacs, Chapter #14 | Mary Schooler csa14@yahoo.com | • First contact Feb 4th, 2015<br>• Invalid email |
| Palm Springs – Resource: Celiac Support | Taylor Cushmore TaylorCush@aol.com | • First contact Feb 4th, 2015<br>• Invalid email |
| Solano County Celiacs | Crystal Elizabeth SolanoCountyCeliacs@gmail.com | • First contact Feb 4th, 2015<br>• Invalid email |
| Sacramento: Celiac Support | Diane Craig dcraig101@hotmail.com | • First contact Feb 4th, 2015<br>• Invalid email |
| Redlands Area Celiac Sprue | Robert V. Breunig bbreunig@mail.ucr.edu | • First contact Feb 4th, 2015 |

| | | |
|---|---|---|
| Support Group | | • Invalid email |
| San Diego Celiac Sprue Association (CSA) | Debbie Toon<br>toon.debbie@gmail.com | • First contact Feb 4th, 2015<br>• Debbie forwarded my information to Roxie Johnson on Feb 5th.<br>• Roxie Johnson would like to put my information on their website for a month so I sent the link (Feb. 6th) |
| The San Gabriel Valley Celiac Support Group | Lynne Turner<br>travelynne812@yahoo.com | • First contact Feb 4th, 2015<br>• Invalid email |
| Santa Cruz Celiac Support Group | Pam Newbury<br>pknewbury@earthlink.net | • First contact Feb 4th, 2015<br>• Invalid email |
| Stanford Celiacs | Kelly Rohlfs<br>kellyr@bonair.stanford.edu | • First contact Feb 4th, 2015<br>• Invalid email |
| Celiac Disease Foundation – Temecula | Ramona Inman<br>Ramonacdf@aol.com | • First contact Feb 4th, 2015<br>• Invalid email |
| Ventura County – Celiac Support Group | Kathy Button<br>venturaceliac@sbcglobal.net | • First contact Feb 4th, 2015<br>• Invalid email |

**Facebook Groups:**

| **Group** | **Contacted** |
|---|---|
| Celiac Disease Support Group | • First contact Jan. 12th, 2015<br>• Second contact Jan. 26th<br>• Final contact Feb. 2nd |
| Celiac.com – Celiac Disease and Gluten-free Diet Information Since 1995 | • First contact Jan. 12th, 2015<br>• Second contact Jan. 26th<br>• Final contact Feb. 2nd |

**Local Gluten-free stores/restaurants:**

| **Name** | **Contact** | **Contacted** |
|---|---|---|
| Nadia's Market, | Nadia Baronas | • First contact Jan. 21st , |

| | | |
|---|---|---|
| St. Catharines | nbaronas@nadiasmarket.com | 2015<br>• Nadia Baronas replied Jan 22nd, 2015 saying she would like to help with my survey<br>• I emailed back 22nd with the link and more information.<br>• She then agreed to post it on their Facebook page and then send it out next week in their weekly email. |
| Lettuce Love, Burlington | ieat@lettucelovecafe.com<br>Mike Rennie (GM): Mike@lettucelovecafe.com | • First contact Jan. 21st , 2015<br>• Second contact Feb 4th<br>• Final contact Feb 11th |

- Contacted all the people I know who live on a gluten-free diet January 12th, 2015

- Contacted all friends and family who could pass the script and link along January 12th, 2015

Appendix F: Letter of Invitation

**Title of Study:** A Life without Wheat: Dietary Adherence, Physical Activity, and Motives
**Principal Student Researcher:** Amy M. Crawford, MSc Candidate, Faculty of Applied Health Sciences, Brock University
**Faculty Supervisor:** Dr. Diane E. Mack, Professor, Department of Kinesiology, Faculty of Applied Health Sciences, Brock University

Dear Participant,

**Introduction:** You are invited to participate in the research project entitled, "*A Life without Wheat: Dietary Adherence, Physical Activity, and Motives*". The researchers involved are members of the Behavioural Health Sciences Research Lab at Brock University and are interested in dietary adherence, physical activity behaviour and motivation.

**Purpose:** The purpose is to examine dietary adherence, physical activity and the reasons why individuals living on a gluten-free diet engage in these lifestyle behaviours.

**Involvement:** Your involvement in this study would be greatly appreciated as it will help in understanding gluten-related dietary restrictions and how this diet may play a role in physical activity and dietary behaviours. You will be asked to provide some background information (e.g., age, gender), identify why you live a gluten-free lifestyle and complete a series of questionnaires that will be administered online. Completing these questions should take no longer than fifteen minutes.

**Benefits:** There are a number of benefits associated with participating in this study. First, participation in this research study may translate into increased knowledge regarding your reasons for adhering to a gluten-free diet and engaging in physical activity. Second, it is likely that through participation in this research project you will become more aware of your own dietary adherence, physical activity levels, and reasons for pursuing these lifestyle choices. The knowledge gained from this research study will ultimately add to the growing evidence around gluten-free living which may lead to intervention-based research.

**Feedback:** There will be a written summary of our results from this study available upon request. Group-level results will be made available. Should you wish to receive these results, please complete the Debriefing Form located at the end of the questionnaire. Our findings will also be available in academic journals and conference presentations; however, your identity will remain confidential.

**Confidentiality:** Any information that is provided from participants will be treated with confidentiality and the data will be completely anonymous as there will be no personal identifiers. All recorded data will be kept on a secured internet site (i.e., www.fluidsurveys.com), which is accessible only to members of the research team.

Information linked to debriefing will be stored on a password protected computer in a locked office (WH 141). All data collected will be held 5-years post publication and then destroyed.

**Participation:** Participation in this study is voluntary and individuals may decline answering any question(s) that you choose. There are no known psychological or physical risks associated with participation. You can choose to decline or withdraw at any time throughout the study. You can do this by closing the browser window. If you withdraw prior to completing the survey, your data will not be used. Should you want to withdrawal post-survey completion, this is not possible as there is no self-identifying information, which makes the survey completely anonymous. However, your participation is requested and would be appreciated as it will improve the conclusions derived from this investigation. All the data collected from this study will be de-identified (i.e., all identifying information will be removed) and used as data only.

The study has been reviewed and has received ethics clearance through the Bioscience Research Ethics Board at Brock University (FILE #:14-099).

Should you have any further questions concerning the study in general, please feel free to contact members of the research team. Amy Crawford can be reached at: (905) 688-5550 ext. 5564 or by email ac09nn@brocku.ca. Diane Mack, Ph.D. can be reached at: (905) 688-5550 extension 4360 or by e-mail at dmack@brocku.ca. Additionally, concerns about your involvement in the study may also be directed to the Research Ethics Officer in the Office of Research Services at (905) 688-5550 extension 3035.

Thank you for your interest and involvement in this study.

Sincerely,

Diane Mack, Ph.D.
Professor

Amy Crawford, BKin,
MSc Candidate

Appendix G: Informed Consent

**Title of Study:**
A Life without Wheat: Dietary Adherence, Physical Activity, and Motives

**Principal Student Researcher:**
Amy Crawford, MSc Candidate, Faculty of Applied Health Sciences, Brock University; ac09nn@brocku.ca

**Faculty Supervisor:**
Dr. Diane E. Mack, Professor, Department of Kinesiology, Faculty of Applied Health Sciences, Brock University; dmack@brocku.ca

You have been invited to participate in a research study.

- The purpose is to examine dietary adherence, physical activity and the reasons why individuals living on a gluten-free diet engage in these lifestyle behaviours.

I understand that:

- I have received and read the Letter of Invitation provided to me through members of the research team conducting this study.
- I understand that participation will involve completing a 69-item questionnaire that will take approximately 15 minutes of my time on a single occasion.
- I understand the purpose is to examine dietary adherence, physical activity and the reasons why individuals living on a gluten-free diet engage in these lifestyle behaviours.
- I understand that I can choose to decline participation at any point in time throughout the study.
- I understand that the following inclusion/exclusion criteria are being used in this research study to guide participant recruitment: (a) self-identified as living on a gluten-free diet, (b) have consented to participate, (c) between the ages of 18-64, (d) must be able to understand and speak English, (e) willing to complete a series of questionnaires and, (f) must have access to both a computer and Internet.
- No physical activity is being delivered or offered.
- I understand that there are no known or anticipated risks associated with participation.
- I understand that background information requires the disclosure of personal information.
- I understand that there is no obligation to answer any question that I do not wish to answer.
- I understand that members of the research team have secured procedures to ensure participant confidentiality.
- I understand that the data will be completely anonymous as there will be no personal identifiers.
- I understand that my participation in this study is voluntary and that I may withdraw from the study at any time and for any reason without penalty. I can do this by closing the browser window. If I withdraw prior to completing the survey,

my data will not be used. Should I want to withdrawal post-survey completion, this is not possible as there is no self-identifying information, which makes the survey completely anonymous.

- ❖ I understand that only members of the research team named above will have access to the data. Data will be entered on a secured internet site (www.fluidsurveys.com) and will be downloaded on computer stored in a locked office at Brock University.
- ❖ I understand that information linked to debriefing will be stored on a password protected computer in a locked office (WH 141).
- ❖ I understand that I may gain a better understanding of the reasons why I adhere to a gluten-free diet and engage in physical activity.
- ❖ I understand that the data will be held 5-years post publication and then will be destroyed.
- ❖ I understand that the results of this study will be distributed in academic journal articles and conference presentations, and a summary of the results will be made available to the participants in the study at their request.
- ❖ As indicated by my consent below, I acknowledge that I am participating freely and willingly.

I agree to participate in this study described above. I have made this decision based on the information I have read in the Informed Consent Letter. I have had the opportunity to receive any additional details I wanted about the study and understand that I may ask questions in the future. I understand that I may withdraw this consent at any time. Please retain a copy of this form for your own records.

| | | |
|---|---|---|
| | I consent to participate in this study by checking this box. | DATE: |

If you have any questions about this study or require further information, please contact the Principal Student Investigator or the Principal Investigator using the contact information provided above. This study has been reviewed and received ethics clearance by through the Research Ethics Board at Brock University (FILE #:14-099). If you have any comments or concerns regarding your rights as a participant, please contact the Research Ethics Office at (905) 688-5550.

Appendix H: Questionnaire Package

*Section 1: This first part of the questionnaire is designed to describe the people participating in this study. All information received is held in confidence. Please provide your …*

1. Age _____ *(in years)*

2. Gender? _____

3. What is your height? _____ *(cm)* **OR** _____(*ft*) _____(*inches*)

4. What is your weight? _____ (*kg*) **OR** _____ *(pounds)*

5. What is your current marital status?

   a) Single/Never married
   b) Married/Common Law
   c) Widowed
   d) Divorced/Separated

6. How would you describe your ethnic origin?

   a) Aboriginal
   b) African American
   c) Asian
   d) Caucasian
   e) Other

7. What is your highest level of education?

   a) Less than High School Diploma
   b) High school diploma
   c) College Diploma or Certificate or Trade
   d) University Degree
   e) Masters
   f) Doctorate

8. What is your employment status?

   a) Employed
   b) Unemployed

c) Volunteer
d) Student

9. Why are you consuming a gluten-free diet?

a) Diagnosed with Celiac Disease
b) Diagnosed with a Wheat Allergy
c) Diagnosed with a Non-Celiac Gluten Intolerance
d) By Choice
e) Other: _____

10. How long have you been living on a gluten-free diet?

_____ (*years);* _____ (*months)*

*Section 2: Please fill in the following questions based on how many times YOU consumed gluten over the past week.*

1. Accidental gluten ingestion: _____ *times per week*
2. Purposeful gluten ingestion: _____ *times per week*

*Section 3: During a typical **7-Day period** (a week), how many times on average do you do the following kinds of physical activity for **more than 15 minutes** during your free time (write in each space the appropriate number)*

| Intensity of Activity | Times Per Week |
|---|---|
| **Strenuous Activity** *(Heart beats rapidly)*<br><br>Examples of strenuous exercise include: heavy lifting, aerobics, fast bicycling, carrying heavy objects or groceries (25+ lbs) upstairs, shovelling snow, etc. | |
| **Moderate Activity** *(Not exhausting)*<br><br>Examples of moderate exercise include: carrying light loads, bicycling at a regular pace, easy swimming, dancing, heavier house cleaning (i.e., washing windows, scrubbing floors), heavier outdoor work (digging, mowing, snowblowing), etc. | |
| **Mild Activity** *(Minimal effort)*<br><br>Examples of mild exercise include: yoga, easy walking, slow dancing, fishing, bowling, golf, light housekeeping, light home repairs, light gardening, shopping, etc. | |

*Section 4: There are a variety of reasons why people regulate their eating behaviours.*
*Different people have different reasons for eating a gluten-free diet, and we want to know a little bit more about why you choose to do so currently or would choose to do so in the future. The following questions outline different reasons why you currently do (or would) eat a gluten-free diet. Please indicate the extent to which each reason is true for you on the scale provided.*

| **Why are you eating a gluten-free diet?** | Does not correspond at all | | | | | | Corresponds exactly |
|---|---|---|---|---|---|---|---|
| 1. I don't want to be ashamed of how I look | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. I don't know why I bother | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. Eating a gluten-free diet is part of the way I have chosen to live my life | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. Other people close to me will be upset if I don't | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. I would be humiliated if I was not in control of my gluten-free diet | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. I can't see what I'm getting out of it | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 7. I can't see how my efforts to eat a gluten-free diet are helping my health situation | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8. It's fun to create meals that are gluten-free | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 9. I believe it's a good thing I can do to feel better about myself in general | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 10. I believe it will eventually allow me to feel better | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 11. For the satisfaction of eating gluten-free | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 12. I take pleasure in fixing gluten-free meals | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 13. I truly have the impression that I'm wasting my time | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 14. Eating a gluten-free diet is congruent with other important aspects of my life | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 15. Other people close to me insist | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 16. Eating a gluten-free diet is an | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| integral part of my life | | | | | | | |
| 17. It is a way to ensure long-term health benefits | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 18. It is a good idea to try and regulate my gluten-free diet | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 19. I like to find new ways to create meals that are good for my health | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 20. Regulating my gluten-free diet has become a fundamental part of who I am | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 21. It is expected of me | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 22. I would feel ashamed of myself if I was not eating a gluten-free diet | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 23. People around me nag me to do it | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 24. I feel I must absolutely be thin | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

***Section 5: Why are you physically active?*** *The following list identifies reasons why people are physically active. Please indicate on the scale provided how true each statement is for YOU with (0) = Not true for me and (4) = Very true for me.*

| | Not true for me | Sometimes true for me | Moderately true for me | Often true for me | Very true for me |
|---|---|---|---|---|---|
| 1. I feel like a failure when I haven't been physically active in a while. | 0 | 1 | 2 | 3 | 4 |
| 2. I get restless if I'm not physically active regularly | 0 | 1 | 2 | 3 | 4 |
| 3. I participate in physical activity because it has become a fundamental part of who I am | 0 | 1 | 2 | 3 | 4 |
| 4. I am physically active because it is consistent with me values | 0 | 1 | 2 | 3 | 4 |
| 5. I think it is important to make the effort to be physically active regularly | 0 | 1 | 2 | 3 | 4 |
| 6. I find being physically active a pleasurable activity | 0 | 1 | 2 | 3 | 4 |
| 7. It's important to me to be physically active regularly | 0 | 1 | 2 | 3 | 4 |
| 8. I take part in physical activity because it is consistent with my life goals | 0 | 1 | 2 | 3 | 4 |
| 9. I consider physical activity to be an important part of my identity | 0 | 1 | 2 | 3 | 4 |
| 10. I get pleasure and satisfaction from participating in physical activity | 0 | 1 | 2 | 3 | 4 |
| 11. I feel under pressure from my friends/family to be physically active | 0 | 1 | 2 | 3 | 4 |
| 12. I am physically active because it is fun | 0 | 1 | 2 | 3 | 4 |
| 13. I am physically active because other people say I should | 0 | 1 | 2 | 3 | 4 |
| 14. I feel ashamed when I | 0 | 1 | 2 | 3 | 4 |

| | | | | | |
|---|---|---|---|---|---|
| miss a physical activity session | | | | | |
| 15. I am physically active because others will not be pleased with me if I don't | 0 | 1 | 2 | 3 | 4 |
| 16. I enjoy my physical activity sessions | 0 | 1 | 2 | 3 | 4 |
| 17. I feel guilty when I am not physically active | 0 | 1 | 2 | 3 | 4 |
| 18. I take part in physical activity because my friends/family/spouse say I should | 0 | 1 | 2 | 3 | 4 |
| 19. I value the benefits of physical activity | 0 | 1 | 2 | 3 | 4 |
| 20. I don't see why I should have to be physically active | 0 | 1 | 2 | 3 | 4 |
| 21. I can't see why I should bother being physically active | 0 | 1 | 2 | 3 | 4 |
| 22. I don't see the point in being physically active | 0 | 1 | 2 | 3 | 4 |
| 23. I think being physically active is a waste of time | 0 | 1 | 2 | 3 | 4 |

*Thank you for completing this questionnaire.*

*Your time is much appreciated and your information is important to us!*

- *Sincerely, the Research Team*

## Appendix I: Debriefing Form

If you would like to receive a summary of the results of the study please complete the following information.

*Please check if you would like to receive results:*

_____ I would like to receive a brief summary of the final results from this study

If you would like to receive the information **by e-mail**:

Name:
_____

E-Mail Address:
_____

If you would like to receive the information **by mail** please provide your name and address:

Name:
_____
(First Name) (Last Name)

Address:
_____
(Street Number) (Street)

_____
___
(City) (Province) (Postal Code)

## Tables

Table 1

*Demographic Descriptive Statistics*

| | Total ($n$ = 202) | | | |
|---|---|---|---|---|
| Variable | *M* | *SD* | *Skew.* | *Kurt.* |
| Age | 42.35 | 12.43 | -.15 | -1.14 |
| Height (cm) | 166.22 | 7.64 | .45 | .44 |
| Weight (kg) | 69.89 | 16.96 | 1.59 | 3.89 |
| BMI | 25.22 | 5.42 | 1.29 | 2.07 |
| Length of Gluten-free Lifestyle (months) | 79.4 | 88.46 | 1.91 | 3.26 |
| | % ($n$) | | | |
| Gender | | | | |
| Male | 7.5 (15) | | | |
| Female | 92.0 (185) | | | |
| Marital Status | | | | |
| Single/Never Married | 20.4 (40) | | | |
| Married/Common Law | 71.9 (141) | | | |
| Divorced/Separated | 7.7 (15) | | | |
| Ethnic Origin | | | | |
| Aboriginal | 1.0 (2) | | | |
| African American | 0.5 (1) | | | |
| Asian | 1.0 (2) | | | |
| Caucasian | 96.0 (191) | | | |
| Other | 1.5 (3) | | | |

| | |
|---|---|
| Highest Level of Education | |
| Less than High School Diploma | 0.5 (1) |
| High School Diploma | 9.5 (19) |
| College Diploma or Certificate or Trade | 26.4 (53) |
| University Degree | 35.8 (72) |
| Masters | 21.4 (43) |
| Doctorate | 6.5 (13) |
| Employment Status | |
| Employed | 69.7 (140) |
| Unemployed | 15.4 (31) |
| Volunteer | 4.5 (9) |
| Student | 10.4 (21) |
| Reason for Consuming Gluten-Free Diet | |
| Diagnosed with Celiac Disease | 76.1 (153) |
| Diagnosed with a Wheat Allergy | 3.5 (7) |
| Diagnosed with Non-Celiac Gluten Intolerance | 9.0 (18) |
| By Choice | 11.4 (23) |

*Note. M = Mean. SD = Standard Deviation. Skew = Skewness. Kurt = Kurtosis. All totals may not add to 202 due to missing data.*

Table 2

*Descriptive Statistics and Internal Consistency Reliability Estimates*

| Variable | *M* | *SD* | *Range* | *Skew.* | *Kurt.* | *α* |
|---|---|---|---|---|---|---|
| 1. REBS Intrinsic | 3.76 | 1.80 | 6.00 | .06 | -.96 | .83 |
| 2. REBS Integrated | 5.48 | 1.37 | 6.00 | -.72 | -.28 | .57 |
| 3. REBS Identified | 5.48 | 1.55 | 6.00 | -1.05 | .43 | .72 |
| 4. REBS Introjected | 1.95 | 1.18 | 5.25 | 1.26 | 1.08 | .58 |
| 5. REBS External | 2.13 | 1.40 | 6.00 | 1.27 | .84 | .70 |
| 6. BREQ-2R Intrinsic | 2.69 | 1.18 | 4.00 | -.73 | -.50 | .95 |
| 7. BREQ-2R Integrated | 2.40 | 1.29 | 4.00 | -.40 | -1.09 | .93 |
| 8. BREQ-2R Identified | 2.91 | .97 | 4.00 | -.97 | .44 | .87 |
| 9. BREQ-2R Introjected | 1.30 | 1.05 | 4.00 | .63 | -.44 | .82 |
| 10. BREQ-2R External | .56 | .80 | 3.75 | 1.84 | 3.36 | .87 |
| 11. GFD Adherence | .51 | 1.20 | 10.00 | 4.22 | 23.77 | -- |
| 12. LTEQ | 65.07 | 47.70 | 340.00 | 2.51 | 10.17 | -- |

*Note:* M = Mean. SD = Standard deviation. Skew. = Univariate Skewness. Kurt. = Univariate Kurtosis. α = Cronbach's (1951) internal consistency reliability coefficient. REBS = Regulation of Eating Behaviours Scale (Pelletier et al., 2004). BREQ-2R = Behavioural Regulation in Exercise Questionnaire (Markland & Tobin, 2004; Wilson et al., 2006). GFD = Gluten-free diet. LTEQ = Leisure Time Physical Activity Questionnaire (Godin & Shephard, 1985). Outliers were removed from LTEQ based on z-scores $\geq$ 3.00 and $\leq$ - 3.00 prior to calculating these values.

Table 3

*Estimates of Effect Size (By Choice compared to Medically Advised)*

| Subscale | Cohen's *d* |
|---|---|
| REBS | |
| Intrinsic | 0.17 |
| Integrated | -0.05 |
| Identified | 0.01 |
| Introjected | -0.07 |
| External | -0.45 |
| BREQ-2R | |
| Intrinsic | 0.30 |
| Integrated | 0.19 |
| Identified | 0.16 |
| Introjected | 0.04 |
| External | -0.07 |

*Note: REBS = Regulation of Eating Behaviours Scale (Pelletier et al., 2004). BREQ-2R = Behavioural Regulation in Exercise Questionnaire (Markland & Tobin, 2004; Wilson et al., 2006).*

Table 4

*Pearson Bivariate Correlations between 2-item GFD Adherence and REBS Variables*

| Construct | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. GFD Adherence | -- | | | | | |
| 2. Intrinsic | -.03 | -- | | | | |
| 3. Integrated | -.15 | .58 | -- | | | |
| 4. Identified | .07 | .60 | .65 | -- | | |
| 5. Introjected | .02 | .25 | .23 | .34 | -- | |
| 6. External | -.08 | .24 | .22 | .25 | .49 | -- |

*Note. GFD = Gluten-free Diet. REBS = Regulation of Eating Behaviours Scale (Pelletier et al., 2004). n = 192.* All *r*-values > |0.12| were statistically significant in this sample at $p \leq 0.05$ (one-tailed significance).

Table 5

*Pearson Bivariate Correlations between LTEQ and BREQ-2R Variables*

| Construct | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. LTEQ | -- | | | | | |
| 2. Intrinsic | .54 | -- | | | | |
| 3. Integrated | .49 | .79 | -- | | | |
| 4. Identified | .53 | .82 | .85 | -- | | |
| 5. Introjected | .01 | .29 | .21 | .23 | -- | |
| 6. External | -.15 | -.19 | -.13 | -.16 | .37 | -- |

*Note. LTEQ = Leisure Time Physical Activity Questionnaire (Godin & Shephard, 1985). BREQ-2R = Behavioural Regulation in Exercise Questionnaire (Markland &Tobin; Wilson et al., 2006). n = 183. All r-values > |0.12| were statistically significant in this sample at $p \leq 0.05$ (one-tailed significance).*

Table 6

*Regression predicting 2-item gluten-free dietary adherence*

| Variables | $\beta$ | *t* | *p* | $r_s$ |
|---|---|---|---|---|
| REBS - Intrinsic | -.02 | -.17 | .86 | -.12 |
| REBS - Integrated | -.32 | -3.25 | .00 | -.53 |
| REBS - Identified | .30 | 2.88 | .00 | .24 |
| REBS - Introjected | .05 | .59 | .56 | .08 |
| REBS - External | -.10 | -1.28 | .20 | -.29 |

*Note.* REBS = Regulation of Eating Behaviours Scale (Pelletier et al., 2004). $\beta$ = Beta. *t* = t-value. *p* = probability value. $r_s$ =structure coefficient. *n* = 192.

Table 7

*Regression predicting physical activity behaviour (LTEQ scores)*

| Variables | $\beta$ | *t* | *p* | $r_s$ |
|---|---|---|---|---|
| BREQ-2R Intrinsic | .28 | 2.50 | .01 | .94 |
| BREQ-2R Integrated | .06 | .45 | .65 | .86 |
| BREQ-2R Identified | .28 | 2.09 | .04 | .93 |
| BREQ-2R Introjected | -.10 | -1.46 | .15 | .01 |
| BREQ-2R External | -.00 | -.03 | .98 | -.25 |

*Note.* BREQ-2R = Behavioural Regulation in Exercise Questionnaire-2R (Markland & Tobin, 2004; Wilson et al., 2006). LTEQ = Leisure Time Exercise Questionnaire (Godin & Shephard, 1985). $\beta$ = Beta. *t* = t-value. *p* = probability value. $r_s$ = structure coefficient. *n* = 183.

Table 8

*Abbreviations*

| Abbreviation | Full Term |
|---|---|
| CD | Celiac Disease |
| GFD | Gluten-free Diet |
| PA | Physical Activity |
| OIT | Organismic Integration Theory |
| SDT | Self-Determination Theory |

**Figures**

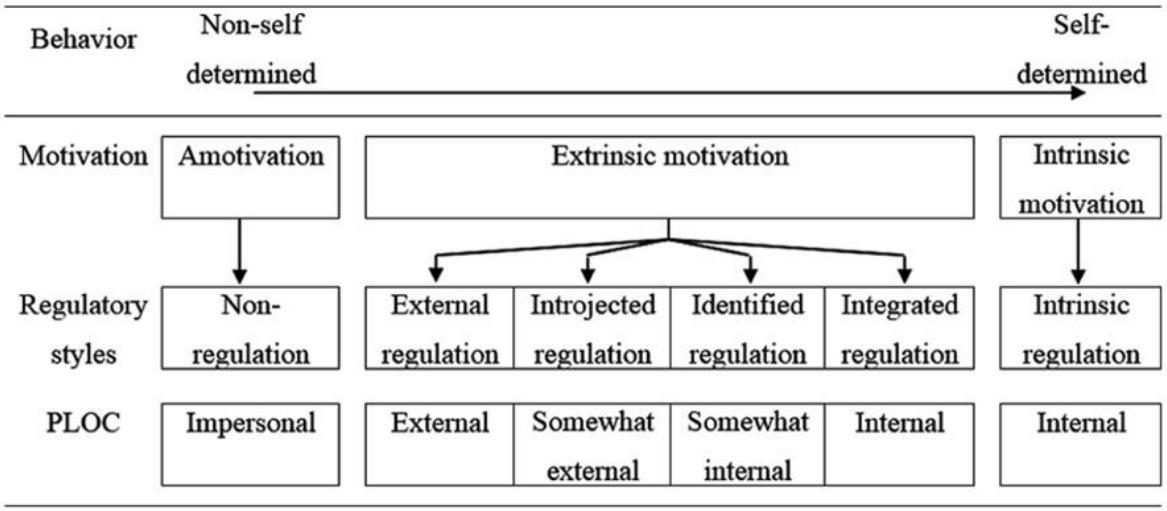


*Figure 1.* An image showing types of motivation through the Self-Determination Theory Continuum.